Railway mechanical and electrical engineer

AMERICAN

RAILROAD JOURNAL,

AND

MECHANICS' MAGAZINE.

44

VOL. I.—THIRD SERIES,
OR
VOL. XVI.

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To Subscribers.

Having advocated the principle of low fares, we are determined not to suffer our practice to fall behind our doctrine. Although our circulation from the nature of the work, is limited to those engaged, or, in any wise interested in Internal Improvement, we hope to increase the number of these, and enlist all classes in its favor. The American Railroad Journal, was commenced when but *one hundred miles* of Railway were in use in the United States. Now there are nearly *five thousand*—and having continued thus far under many difficulties, we consider that an ample guarantee has been given for its future continuance. Being desirous of strictly adopting the *cash system*, and of accomodating ourselves, to the spirit of the times we propose making the following changes.

The American Railroad Journal will hereafter be published once a month, and on the first day of each month. Each monthly number will contain 32 pages. The original matter will be printed in the same type as heretofore but not *leaded* so that each page will contain one third more than before. All selected matter will be printed in smaller type—but in general it will be our endeavor to give a condensation of foreign and domestic intelligence rather than mere selections. Each volume will therefore contain as much, if not more matter than formerly, and the result of more editorial labor.

By this arrangement the postage to distant subscribers will also be greatly reduced.

The terms will hereafter be

Three dollars a year if paid on receipt of the first number.
Five dollars for two years, if paid likewise in advance.
And Five dollars a year to those who do not pay in advance.

Subscribers who have paid five dollars in advance from July 1842 will therefore receive the Journal, until January 1844, instead of July 1843.

Subscribers who do not pay on receipt of this number, being already six months in arrears, will be charged Five dollars to July 1843.

To those of our subscribers, who, by prompt payment, or any other assistance have given us their support we return our warmest thanks, with the assurance that no effort will be spared to repay their confidence.

From various causes, and also in order to issue an extra impression of this number some delay has arisen. Arrangements are making, by which the numbers hereafter, can be sent to city subscribers, and mailed to others, on, or before the first day of each month.

The Progress of Railroads since the Commencement of the American Railroad Journal.

The History of Railroads in the United States presents one of the most remarkable instances of the rapid progress of invention which has ever been recorded. A few years since the advocates of Railroads were ranked among visionaries and schemers, but so rapid has been the growth of the system among us that the small begining and its recent date are very generally forgotten. The history of this Journal will afford evidence upon this point which may suggest useful reflections. Eleven years ago the first number of the American Railroad Journal was isued by Mr. D. K. Minor. This number contains a list of works already in construction and partly finished. As nearly as can be ascertained the following list contains the whole amount of Railroads then in use.

Baltimore and Ohio	60	miles	completed	and in use.
Albany and Schenectady	12	"	"	"
Charlestown and Hamburg about	20	"	"	"
Mauch Chunk	9	"	"	"
Quincy near Boston	6	"	"	"

Thus there were but 92 miles in use upon any of the main lines of Railroads.

So little indeed was there known, and so little could there be said on the subject that the Editor announced, that a part only of the

Journal would be devoted to the subject of internal communication —that the larger part would be occupied with literary and miscellaneous matter as prepared for the New York American. But small as the quantity of matter was, several vigorous articles might even now be read with profit, and among these we might mention those relative to the comparative merits of Railroads and Canals. Although for nearly one hundred and fifty years *tram roads* had been used for the transportation of the heaviest articles such as coal, ore and stone—it was suddenly discovered that Railroads might indeed be profitably employed in transporting passengers and *light parcels*, but that beyond this they were not able to do any thing. The arguments which were then used and which have since been urged with so much force from time to time have not been without effect.

An idea of the small amount of business connected with Railroads, at the time of the commencement of the Journal, may be formed from the fact that throughout the first volume, but three advertisements, (excepting notices to contractors,) are to be found. The first of these was by Mr H. Burden of Troy, another by Messrs. A. & G. Ralston of Philadelphia and another by Townsend and Durfee, Palmyra N. Y.—the first two of which in some shape or other have been continued, and are yet to be found upon our cover.

The Editor also thought necessary to refer to several gentlemen of this city as guarantees for the continuance of the work. Before many numbers had been issued, information from all quarters poured in and a very lively interest was felt in the undertaking. The demand for Railroads throughout the country increased and popular as well as scientific information was in request.

Let us now compare the present state of affairs with this humble commencement. There are now between *four and five thousand* miles of Railroad in use in the United States built by the expenditure of nearly one hundred millions of dollars. Eleven years ago there were but about one hundred miles in use.

There are now probably more than *five hundred* locomotive engines in use nearly all of them made in this country. Eleven years ago the few engines in use were imported from England and were of the oldest patterns. Since then fifty or more American engines have been sent abroad, some to Russia—some to Austria and several to England. Had this fact been predicted even in the most indirect manner in the first number of the Railroad Journal, it would have sealed its doom.

Eleven years ago a dead level was by many deemed necessary

on a Railroad (see p. 68, vol. 1,) and grades of 30 feet to the mile were hardly thought admissible. Now, Engines are in daily use which surmount grades of 60 and 80 feet to the mile.

Eleven years ago inclined planes with stationary power were considered the neplus ultra of engineering science—now they are discarded as expensive, inconvenient and incompatible with the free use of a Railroad.

Eleven years ago it was thought that Railroads could not compete with canals in carrying heavy freight, and even much more recently, statements to this effect have been put forth by authority. Now we know that the most profitable of the Eastern Railroads derives one half its income from bulky freight—and that coal can be carried more cheaply upon a Railroad than in canals.

Eleven years ago the profitableness of Railroads was not established and discouraged by the vast expenditure in several cases of experiment in an untried field, many predicted that they would be unprofitable. Now it is already demonstrated by declared dividends, that well constructed Railroads when divested of extraneous incumbrances are the most profitable investments in our country. The New England Railroads have paid since their completion 6 to 8 per cent.—Several other roads 6 and 7 per cent. The Hudson and Mohawk of 15½ miles costing about one million, one hundred thousand, paid in 1840 *seven* per cent. on that enormous outlay. The Utica and Schenectady, and Syracuse and Utica, pay 10 to 12 per cent. The Stock of the Utica and Schenectady Railroad has never been down to par since operations were commenced in 1836 and has maintained its stand without fluctuation at a higher rate than any other species of stock during all our commercial revolutions.

Eleven years ago there were but six miles of Railroad in use in the vicinity of Boston. Now Boston has direct connection with a web of Railways *one thousand two hundred and three miles in length*, all of which except about 24 miles are actually in use, being a greater length of Railroad than there was in the whole world, eleven years ago.

We have but one instance to record of a want of correspondence with the general advance of the system. In the first number of the Railroad Journal at the head of the list of applications to the Legislature for charters, we find the New York and Erie, and New York and Albany Railroads. Throughout the first volume, and in each succeding volume are to be found various articles in behalf of these two works. Neither of them is yet completed. One has

a portion complete, and in successful operation, the other has barely commenced construction. That these great works have not yet been finished is no fault of their friends, who have with untiring industry, advocated their claims and that of Railroads generally—and indeed we may safely say that the Railroad system has derived its impetus, in our section of the country at least—from the efforts of those who have labored in behalf of these works. Many untoward circumstances have delayed their construction—but the chief obstacle has been the singular indifference of capitalists in the city of New York—who in one way or other have sunk in this period, more money than would have constructed two works which would have rendered our city a commercial focus, unrivalled in the world.

A better feeling now exists, and we hope, ere long, to see the fulfilment of our best wishes—indeed it is no longer a matter of choice but of necessity. In the city of New York taxes have increased to such an amount that unless every effort is made to concentrate the business of the country, trade will flow through other channels, and find a more ready outlet, where enterprise and capital may direct.

We would do great injustice to the spirit of enterprise in our country, were we to omit mention of another great work which has been completed in this period—the Croton Acqueduct—one of the finest achievements of Engineering science in modern times. This magnificent work, by an acqueduct of 32 miles in length is designed to furnish an abundant supply of the purest water ever tasted by man, to the City of New York. The whole character of the work in that of solidity and utility—with no attempts at display, it impresses the mind solely by its magnitude and great value. The Acqueduct Bridge, at Harlem River when completed will not suffer from a comparison with any similar structure in the world.

When we seriously contemplate the great things which have thus been accomplished in the brief space of eleven years, can we wonder that the friends of Railroads, place unbounded reliance in that energy and spirit of enterprise which have already performed so much, trusting that in such a vast and active nation as our own the germ of prosperity will never perish, even if retarded in its growth by untoward circumstances or injured by national calamity. Nor can it create surprise that those who have endeavored to record the rapid advance of this great national enterprise, should feel enthusiastic in a cause for which they have so long labored and an honest pride in having even in the smallest degree and in the humblest manner contributed to its interest.

IMPORTANT FACTS RELATING TO RAILROADS.

With a view to the diffusion of popular information upon the subject of Railroads we have collected in this number several tables and statements which being short and readily intelligible at a glance may be considered as forming a condensation of Railway statistics. This information is drawn from various authentic sources.—We are indebted for some, to the "Sketch of a Railway" which has been several times noticed in this Journal—but all are derived from official statements, mostly recorded in this work.

PROFIT OF RAILROADS.

The Chev. de Gerstner in the years 1839–40, himself or by his assistant visited every Railroad in the United States, and enjoyed remarkable opportunities for obtaining information. We stated as the result of his observation—that notwithstanding the very short time since these works had commenced operations—and notwithstanding the difficulties of some roads arising from an insufficient capital or a deficient traffic—the average of all the Railroads then in operation in the United States was *a dividend of five and a half per cent., on the capital invested.* He also states that "on all the lines there is a yearly increase of at least 15 to 20 per cent. in the gross income, so that even those which do not pay now will give in a few years a handsome dividend." He also affirms that from the information collected there can be no doubt that the large capital invested in Railroads, will not only produce an incalculable benefit to the country, but also pay the shareholders a dividend which under good management, by the constant progressing population and trade, must likewise from year to year increase."

PROFITS OF VARIOUS RAILROADS.

ROAD.	Length Miles.	Highest Grade p Mile.	COST.	Annual Dividends—per cent.				
				1837.	1838.	1839.	1840.	1841.
Boston and Lowell	25 3/4	10	$1,834,893	7	7	8	8	8
Boston and Providence	41	37 1/2	1,782,000	8	8	8	7	7
Boston and Worcester	44 1/2	42	2,374,547	7 1/2	7 1/2	6	6	7
Lowell and Nashua	14	10	380,000			6 1/2	7 1/2	8
Eastern (incomplete)	60		2,267,000			5	5	6
Taunton Branch	11		250,000			7	6	7 1/2
New Bedford and Taunton	21		400,000				6	6
Norwich and Worcester	58 1/2		1,777,471				6	6
Petersburgh and Roanoke	60		826,000			9		7
Georgia Railroad	47		2,350,000					6
Camden and Amboy	92		2,291,802	18 2/3 per cent per ann. It has earned its cost in 7 years.				
Mohawk and Hudson	15 7/8		1,000,000	7 per cent in 1840.				
Syracuse and Utica	53		893,889	pays 10 to 12 per cent annually.				
Utica and Schenectady	78		1,900,000	pays 11 per cent annually and reserves a large fund, by which it is constructing a second track.				

The *Utica and Schenectady Railroad* has yielded, on an expenditure of $1,900,000, in 5 years and five months, the sum of - - - - - - - - $2,019,979

The whole amount of expenses during the same period, besides paying for the purchase of the Mohawk Turnpike, building 22 miles of road for turnouts, and paying severe taxes, was - - - - - 707,694

Nett receipts in 5 years and 5 months $1,309,285

The *Camden and Amboy Railroad.* By an *official* report from the company, it is shown that this road has earned its entire cost in seven years. It has, however, had to divide its earnings with the Delaware and Raritan Canal, with steamboats and wharves at its two extremes, costing $2,829,797,—on which it had to pay dividends, as well as to its own Stockholders, on a capital of $2,291,802, expended on the Canal, and in steamboats, wharves, real estate, and coal lands, $929,055. The canal, in fact, earning on $\frac{5}{8}$ths of one per cent.

The gross receipts over the Camden and Amboy Railroad, from 1st Jan 1833, to 31st Dec. 1839, was $4,637,535

The gross expenditures during this period. $2,253,993

Net receipts in seven years - - - - $2,383,542

Being more than the cost of the railroad; and this too with but limited accommodations for the transportation of freight, at high charges proportioned to other railroads.

TABLE SHOWING THE LENGTH OF RAILWAYS RADIATING FROM, AND IN CONNECTION WITH, THE CITY OF BOSTON.

		Distances
From Boston, via Albany, to Buffalo		518 miles.
do.	Portsmouth, to Portland, Maine	104 "
do.	Lowell, Nashua, and Concord	62 "
do.	to Providence, Rhode Island	41 "
From Providence to Stonington		47 "
Branch from Andover to Haverhill		25½ "
Dedham Branch		2 "
Taunton Branch, and extension to New Bedford		35 "
Bedford and Fall River		13 "
Norwich and Worcester		58¼ "

New Haven to Hartford, 36, and extension to Springfield 24 miles, not completed	60	"
West stockbridge to Bridgeport	98	"
West Stockbridge to Hudson	33	"
Troy to Shenectady	22	"
Troy to Ballston	20	"
Shenectady and Saratoga	21	"
Lockport, Niagara Falls, and Buffalo	43	"
Miles,	1,203½	

INCREASE OF INCOME ON RAILROADS.

The following table proves that the assertion of the Chev. de Gerstner was correct—that Railroads which are not yet profitable may become so before long, and that those which now pay well, will hereafter produce a still higher profit.

Boston and Lowell, nett revenue, 1836, 89,800
do. 1839, 149,100

$59,300 increase in 3 years.

Bost. and Worces'r. gross revenue, 1835, 119,100
do 1839, 231,800

$112,700 increase in 4 years.

Baltimore and Ohio, gross revenue, 1833, 195,700
do 1840, 432,900

$237,200 increase in 7 years.

Camden and Amboy, nett revenue, 1833, 181,000
do 1839, 427,000

$246,000 increase in 6 years.

Liverpool and Man.'r, nett rev., 1832, 303,000
do 1839, 556,000

$253,000 increase in 7 years.

Columbia and Philadel., nett rev., 1835, 229,351
do 1840, 449,267

$219,916 increase in 5 years.

Liverpool and Manchester opened Sept. 1830. } In ten years the receipts had increased
1840. } 240 per cent.
Grand Junction, " July, 1837. } In three years the receipts had increased
1840. } 90 per cent.
London and Birmingham, " Sept. 1838. } In two years the receipts had increased
1840. } 65 per cent.

Boston and Lowell, revenue from passengers 1837, $117,682
1840, 145,953

$28,311 nearly 5 p. ct. p. an.

Income from freight 1837, $63,137
1841, 121,588

$58,451 or 10 p. ct. p. ann.

Lowell and Nashua Income from freight 1839, $18,406
1841, 56,764

$38,358 or 70 per ct. p. an.

PROPORTION OF EXPENDITURE TO INCOME.

NORTHERN ROADS—PASSENGERS ALMOST EXCLUSIVELY.

	Miles.	*Gross Receipt per annum.*	*Expense per annum.*	*Through passengers per annum.*	*Per cent. of expense on gross receipts.*	*Dividend in 1839.*
Utica and Schenectady,	78	400,700	113,700	130,000	28	11 p. ct.
Utica and Syracuse,	53	251,200	69,300	122,000	27 1-2	11
Mohawk and Hudson,	16	150,500	68,000	188,000	45 1-4	7
Camden and Amboy,	92	685,300	258,000	182,000	39	7
		$1,487,700	509,000	Average 34 1-4 per cent.		

EASTERN ROADS—ABOUT HALF OF RECEIPTS BEING FOR FREIGHT.

Boston and Lowell,	26	241,200	92,100	38	8 p. ct.
Boston and Providence,	41	312,900	93,600	30	8
Boston and Worcester,	44 1-2	231,800	126,400	54 1-2	6
Taunton Branch,	11	58,000	40,700	72	6
Eastern Railroad,	25	125,600	53,200	42 1-4	4 3-4
Nashua and Lowell,	14 1-2	56,000	29,900	54	6
		$1,024,500	435,900	Average 42 1-2 per cent.	

SOUTHERN ROADS—RECEIPTS MAINLY FROM FREIGHT, EXCEPT THE LAST AND FIRST.

Balt. and Washington,	40	202,700	85,200	42	7 p. ct.

Baltimore and Ohio,	69	433,000	290,200	65	4 1-2
Georgia Central,	110	113,800	84,400	30	8
Georgia Railroad,	87 1-2	184,600	70,300	38	9
Balt. and Philadelphia,	93	490,500	164,100	33 1-2	7
		$1,424,600	634,200	Average 44 1-2 per cent.	

From the above variety of proportions borne by the *general expenses* to the gross receipts of railways, we gather that 40 to 45 per cent. would be a fair average for the roads here enumerated leaving 60 to 65 per cent. to pay interest on loans and dividends on capital. But it should be remembered also, that at very little over that ratio of expenditure, a larger business could be done, and larger profits divided. This idea will be more clearly conveyed by stating the fact, that on the Grand Junction railway, in England the cost of motive power was reduced $45,000, and the receipts at the same time increased $70,000 in the year 1840, as compared with 1839. This and some other English roads justify about the same average ratio of expenses, of 40 to 45 per cent., but they are there burthened with government dues, etc., from which our roads are comparatively free.

CAPACITY OF RAILROADS FOR FREIGHT.

To show the immense capacity of a railway, having the drawback of grades of 50 feet, at which stationary power is used, for carrying freight and passengers, we cite the Stockton and Darlington in England, over which there passed in one year,

200,000 passengers.

690,000 tons,

principally coal, which is carried 25 miles, about, at a rate exactly equivalent to $2 per ton, for 100 miles. It makes 14 per cent. clear, and divides 10 per cent., 4 per cent. being reserved as a sinking fund. The price of the stock is £275 for £100 paid. The loads per trip carried over this road are about 65 tons nett of coal, of which they make three per day. The weight of rail on this road which has been in operation fifteen years, was originally only 25 lbs., but it has since been increased to 64 lbs per yard.

CAPACITY OF LOCOMOTIVES FOR FREIGHT BUSINESS.

Trial loads on the Reading Railroad, at an average speed of 12 miles an hour. Engine weighing about eleven tons.

1840.	Engine. 8 wheels.	No. of cars.	Bbls of flour.	Tons of iron, etc.	Tons, Nett load freight.
Jan. 8	The Gowan & Marx	57	1573	66	213
" 15	The Minerva	85	1227	72	316

1839.					
Feb. 20	The Gowan & Marx 6 wheels.	101	2002	78	268
Mar. 6	Hitchins & Harrison	88	1588	70	228
1841.					
Feb. 5	do	102	1479	104	251
Feb. 9	do	105	1318	177	308

EXPENSE OF TRANSPORTING 200 TONS OF COAL.

The trip to and from the coal mines to occupy two days—in trains of 50 cars, at 4 tons each. No allowance is made in the following calculation for back freight. Repairs of engine and cars equal to a renewal every four years.

At an average of 2½ tons of coal for the locomotive for each 100 miles, at an average of $2½ per ton, would be	$6,25
Engine driver's pay per day $2. Fireman's $1,50. Oil 1 gallon $1,	4,50
Repairs of engine per day at a cost of 8,000,	6,75
Expense of locomotive per day,	$17,50
Expense of a car per day at a cost of about $250 per coal car, viz:—attendance, one man to ten cars, $1,25 per day, is per car,	0,12½
Oil ¾ of a pint at 90 cents., per gallon,	0,9½
Repairs to a coal car per day,	0,30
Expense of one car per day,	$0,52
Daily expense of an engine as above, $17,50 per day for two days,	$35,00
Daily expense of a train of fifty cars for two days,	52,00
Total expense of locomotive, and train of 50 cars per trip,	$87,00

These expenses incidental to transportation are less than 50 cents per ton, for a run of 188 miles, without taking into consideration the *return* loads."

COST OF TRANSPORTING PASSENGERS.

The Utica and Syracuse Railroad, 53 miles long—flat bar—carried 122,000 passengers in 1840 at a *total expense* of $69,400. Equal to 57 cents each.

The Utica and Schenectady Railroad, 78 miles long—flat bar—carried 135,000 passengers at a cost of $87,400, or 67 cents each.

Note.—These charges include all expenses of repairs of Road, Mohawk turnpike, fuel, salaries, oil, etc. etc.

TRASPORTATION OF FREIGHT IS PROFITABLE.

In England, abundant proof has been furnished upon this point; but we will cite the experience in the United States, from reports made in 1840, by distinguished engineers:—"The opinion has generally prevailed that a Road to be profitable, must have a large amount of travel, and that the only source of profit is the transportation of passengers, and that, as a general rule, the freight of heavy commodities yields little or no profit. The experience so far, on our Road, demonstrates in the most satisfactory manner the *error* of this opinion. Our freighting business is more than *double* that of passengers and the mail, and this has been done under the disadvantages of having but one train for both purposes, and consequently keep up a *speed* altogether too great for the most advantageous transportation of freight."

L. O. Reynolds, *C. E. Central R. R. Georgia.*

"I can now state *with confidence*, that wherever the transportation is of a mixed character such as agricultural products, general merchandize and passengers, and sufficiently large to justify the construction of a good Railway, that Railways will be found to be not only the most expedicous, *but the* CHEAPEST ARTIFICIAL MEANS OF CONVEYANCE ALREADY KNOWN."

J. Edgar Thompson, *C. E.*
Report to the Directors of Georgia R. R.

STEAMBOAT EXPENSES COMPARED WITH RAILROAD EXPENSES.

Cost of Boat, $70,000, at 7 per cent.,	$4,900
Wear and tear, 12 per cent.,	8,400
Fuel, 220 trips, 40 cords per trip, 8,800 cords, at $5 per cord,	44,000
Insurance on 70,000, at 3 per cent.,	2,100
Oil, tiller-ropes, packing, etc.,	2,400
Wages—1st Captain, $1,500; 2d Captain, $600; 2 Pilots, $800; 2 Engineers, $1,000; 6 Firemen, $960; 10 Deck-hands, $2,000; Steward, $400; 12 Assistant Stewards, $1,440; and Bar-keeper, $400—in all	9,100
	70,900
Deduct interest on capital, to put it on an equal footing with the Railway,	4,900
Average trips per season of eight months, 220, equal to $300 per trip of 150 miles,	$66,000

The above then, brings the cost of running a Steamboat on the

Hudson River to $300 per trip of 150 miles, or at $2,00 per mile, being $1 for each passenger—Reduce the estimated expense 25 per cent., and there still remains 75 cents for each passenger.

A Locomotive and Train, equal to the same number of passengers per trip, including all expenses, and including an allowance for repair of road, but excluding interest on capital to fully cover all expenses, $80 per hundred miles, or at 80 cents per mile, being 40 cents for each passenger.

In Massachusetts the average cost per train per mile, where fuel is comparatively dear, is 85 cents. In Georgia the same average is 61 cents per train per mile, where fuel costs less.

COMPARAITIVE RISK OF RAILROADS AND STEAMBOAT TRAVELLING.

Mr. Lang, in a report to the London Board of Trade, shows by a number of facts, that Railways are the safest of all modes of conveyance, and more particularly safer than Steamboat travelling. From Jan. 1, to July 1, 1841, only three lost their lives from causes beyond their own control. Two suffered from their own folly and negligence—5 were trespassers on the Road, and the remaining 20 were engineers, laborers or workmen on the line of the Road. The number of passengers travelling was 9,122,000. The distance travelled was 182,440,000 miles. The number killed from causes beyond their own control being three, or one to 3,040,666 passengers, only one *passenger* lost his life for each 60,813,333 miles travelled.

COST OF REPAIRS FOR LOCOMOTIVES.

						cts.
Baldwins Engines.	6 on Georgia Railroad run	71,824	at a cost of	$5,453	or per mile	7,50
	12 do do	110,540	do	6,792	do	6,14
	8 Utica and Schenectady,	145,860	do	9,992	do	6,83
	6 on Columbia R. R. run	176,782	do	7,389	do	4,18
	3 on Phil. and Balt. run	48,065	do	523	do	1,08
Norris Engines.	2 on Phil. and Balt. run	44,580	do	787	do	1,76
Various manufacturers.	10 on New Jersey R. R. run	59,033	do	2,956	do	5
		656,684		33,892	average about 5 cts. per mile for *high velocities.*	

SUPERIORITY OF RAILROADS TO CANALS.

To correct the prejudice still exisiting in the minds of some persons we show the following data that Canals are more costly than Railroads.

Public documents but rarely meet the eye of the general reader

and private companies rather mystify than go into details, and the public never derive a clear idea from them. Railways and canals are alike implicated in this charge of want of distinctness in their reports.

We refer to the annexed official statement, to bring the reader better acquainted with the numerous items of expenditure on a canal, which are supposed by many to be a mere trifle. It should dispel such a delusion. And we ask of him, having first the leading features of the railway and canal well fixed in his mind, whether he is not struck with the *comparative exemption* from the ordinary causes of wear and tear of the former over the latter, and of the constant exposure of the canal to constant breaks and to be periodically swept away by freshets, while the railway is, or can be, generally placed aloof from such accidents or danger, and is never dormant, but actively employed the year through.

STATEMENT OF THE DIFFERENT HEADS OF EXPENDITURE ON THIRTY-TWO MILES OF THE CHAMPLAIN CANAL, IN CHARGE OF THOS. A. SHERWOOD, FOR YEAR ENDING 30TH SEPT., 1838.

Structures or Work.	Whole No.	Total cost. of Repairs
Locks,	22	6,960 54
Lock tending, (exclusive of oil,)		2,112 55
Oil for locks,		42 16
New lock gates,		754 86
Waste weirs,		15 53
Culverts, cost of old estimated,		792 45
Farm bridges,	10	2,283 75
Road bridges, cost of old estimated,	9	2,840 01
Repairing scows,	5	6405 6
Lock houses, store houses, and boat sheds,	4	16 22
Timber sheds, and moving timber,		40 05
Raising and repairing tow-pate and berm bank including repairs to slope wall,		4,721 42
Cleaning out bottom of canal during spring repairs,		1,051 03
Dams,		376 99
New slope wall,		1,543 27
Docking, new and old replaced, cost of old estimated,		6,280 60
Repairs of breaches and watching canal,		209 37
Tools' shovels, picks, crowbars, axes, wheelbarrows,		1,74 91

Other works of consequence which do not come under any of the above heads.

Building two-path wall at Whitehall, between canal and creek,	5,337 56
Excavating rock and earth above and below new lock on Wood creek,	1,595 06
Excavation for deposite of streams emptying into canal at Dunham,	644 13
Building one new and repairing old crane,	314 57
Removing old embankment at Whitehall,	288 88
Building wall at Emprey's waste weir.	244 84
Repairing guard gates,	4 07
Excavating slate near Baley's,	294 88
Superintendent's salary $850, and clerk hire 199 50,	1,049 50
Miscellaneous,	866 53
Average, $1,275 per mile,	$40,809 65

The canals in Pennsylvania particularly, are more exposed to damage and delapidation than most others, nearly all of them running parallel to rapid streams. The Erie canal, exempt from this danger, has been enabled to show a better surplus, and a lower average of annual repairs, which is made only $700 to $800 per mile per annum, by the official reports from 1826 to 1838; but much has been seemingly saved since 1835 by the enlargement, the more strongly urged by its advocates on the ground of the necessity there would soon be for renewing all its *locks*, which with all canals, are fully if not more expensive than the renewal of the *sills* and *bridges* on a railway were good drainage and good care obtains. The annual costliness of the Pennsylvania canals is exhibited in the call for appropriations in 1841 by the Canal Commissioners, as follows:

General maintenance and repairs, including $150,000 estimated damage to Deleware Division by freshet of 6th of Jan., 1841,	on 650 miles canal,	$1,072,000,	tolls in 1840,	520,000
General repairs to railways, 82 Columbia and 36 of Portage,	118 " railway,	118,000,	" "	588,000
		$1,190,000		$1,108,400

Being equal to $1,650 per mile for the canals, and $1000 per mile for the railways. Such is the contrast of expenditures and receipts, which fully refutes the claim of some that there is less wear by water than on iron; the former being always reputed among the most destructive of elements. It excites only regret, indeed,

that a system so ill adapted to the character of our country and climate, should have been so heedlessly pursued.

DEFICIENCIES IN THE NEW YORK AND PENNSYLVANIA CANALS.

New York State Canals.	*Length in miles.*	*Deficiency from commencement to* 1840.	*Pennylvania State Canals.*	*Lengths in miles.*	*Deficiency from commencement to* 1840.
Oswego canal,	38	268,574	Juniata Division,	130	101,075
Cayuga and Seneca,	23	146,497	Western do	105	1,821
Chemung canal,	39	241,144	Delaware do	60	51,866
Crooked lake,	8	69,817	Susquehanna do	39	172,523
Chenango,	97	479,560	North Branch do	73	327,065
Black River (unfinished)	38	53,711	Western Branch do	72	372,878
Genesee Valley,	35	122,192	French Creek do	45	129,211
			Beaver do	25	128,158
	278	1,386,495		949	1,284,597

These deficiencies include interest on cost. These deficiencies exclude interest on cost.

The mode of stating the accounts, either in Pennsylvania or New York, is not very strict, as for instance in the latter State, a recent loan of $50,000 for rebuilding the wooden locks of the Chemung canal, and several other items, are charged to *funded debt*, and the new work in locks, aqueducts, etc., on the Erie enlargement, is in lieu of repairs that must otherwise have been incurred. These large deficiencies have undoubtedly been assisted by the totally inadequate business for these particular canals, but had they been railways, even of the early imperfect structure, the result could not have been so disastrous, with their quadruple resource in *freight, toll, passengers*, and the *mail, perennial.*

Report on Dr. Earle's Process.

Sir,—The following documents will explain themselves, as they are of a character to interest many of your readers. They are transmitted for insertion in the "R. R. Journal" by

Your ob't serv't,
Edward Earle.

"Ordnance Office,
Washington, Jan. 12, 1843."

"Hon. J. C. Spencer,
Secretary of War,

Sir,—I have to acknowledge the receipt of a letter from the Hon. R. H. Bayard, of the U. S. Senate, requesting to be informed of "the result of any experiments that may have been made under the auspices of the Department in relation to Dr. Edward Earle's method of preserving Timber and Cordage, together with the opinion of the Department, or of any of its officers, as to its practical value" —the same being referred to this office for a Report.

The great cost of Government Carriages and the difficulty of obtaining suitable timber for their construction, induced this office, early in 1840, to consider whether the interests of the service could not be promoted by the adopting of measures to prevent their decay. "Kyanizing" and Dr. Earle's process "were both duly considered, and the great expense of the former led to the use of the latter by authority of the Secretary of War. Since the Summer of 1840, about 70,000 cubic feet of timber have been cured at the Watervliet Arsenal, the greater part of which is deposited in store for future use. The exact cost of the operation cannot be stated, but it is believed to be about cents per cubic foot, and one and a half cents for the use of the patent right.

Sufficient time has not yet elapsed to prove the value of the process by the trials of gun carriages in service, but during the period of operations the person charged with supervising the curing of the timber (Mr. R. M. Bouton,) has made some experiments which are set forth in a printed paper published by Dr. Earle, which is hereto appended.

Mr. Boulton is a man possessed of much more science than is usually found in such a first rate practical mechanic, and full reliance may be placed in his statements.

Upon a careful examination of the subject, which its importance to this office, in a pecuniary view at least, seemed to demand, I have formed the opinion:

1. That the impregnation of timber with the sulphates of iron and copper may be effected by its immersion in a proper solution of those minerals at a moderate heat, and with timber of any size or length.

2. That timber thus cured will be in a great measure incorruptible, free from the attacks of worms, and from dry rot.

3. That its strength is not reduced, and its toughness or fibrous texture is improved.

4. That the cheapness of the process, united to its beneficial effects, promises a great reduction in the expenditures for such objects as are susceptible to its use, among which canvas and cordage seem to occupy a prominent place;—and, finally,

That this process will furnish the desideratum for the preservation of many things to which it is applicable, and should be patronized by the Government.

The letter of Mr. Bayard is returned herewith.

I have the honor to be, sir
Very respectfully,
Your ob't serv't
G. TALCOTT,
Lt. Col. Ord."

(Indorsed)

"NAVY DEPARTMENT Jan. 17, 1843."

"I unhesitatingly express my full concurrence in the opinion and recommendation of Col. Talcott within given. I have no doubt that Dr. Earle's process might be advantageously applied to a great

variety of materials used in the naval service, and that the saving to the country would be incalculably greater than the cost. I therefore strongly recommend the adoption of Dr. Earle's process, upon such terms as may be considered fair and just between him and the country.

A. P. UPSHUR."

REPORT.

At a meeting of the President and Managers of The Philadelphia and Reading Railroad Company on the 4th day of January, 1843, the following Report was presented, approved, and ordered to be printed for the use of the Stockholders.

To the President and Managers of the
Philadelphia and Reading Railroad Company:

GENTLEMEN,—In accordance with your resolution of the 10th inst., I have the honor to present to you the following Report:—

The entire line of the railroad, between Philadelphia and Mount Carbon, as the Board are aware, was opened for the transportation of freight and passengers, on the 13th day of January last; and on the 17th day of May following, the branch for the accommodation of the coal trade on the Delaware was opened to the Company's wharves at Richmond.

On the opening of the road to Mount Carbon, the transportation of coal was commenced, which increased on the completion of the Richmond branch until limited by the number of cars and engines then owned by the Company. A contract was entered into on the 3d of March, for one thousand coal cars, a large portion of which it was expected would have been delivered in time for the fall trade; and contracts were also made with several different establishments for engines sufficient for their transportation The coal cars to be furnished under this contract, were not received as early as had been anticipated by the Board, and some of the engines are still undelivered. The consequence was, that the force on the road was entirely inadequate to the trade that offered. In addition to this, although the main line of the road was completed, there were numerous additions, such as extra tracks in the coal region, and at Richmond, proper connections with the branch roads, and *sidings*, for the passage of the trains on the road, etc., which were in an unfinished state during the past season, and the want o which would have been as insuperable a bar to a large business, as the want of cars and engines.

In the month of August, when the force on the road was being rapidly increased, and there was a prospect of realizing, to some extent, the expectations of the friends of the road, the operations of the Company were suspended by the destruction by fire, first of the bridge across the Schuylkill at the falls, and shortly after of the bridge across Mill Creek. These structures were rebuilt, and the trade to Richmond recommenced on the 13th of October, and from that time until the close of the shipping season, a regular coal business was done, to the extent of the cars and engines on the road.

Some disappointment has no doubt been experienced by the Board of Managers in consequence of these vexatious interruptions and delays in commencing the transportation of coal, but to some extent they were reasonably to have been expected. The contractors for building the coal cars

were energetic and efficient men, and did all in their power to complete them as speedily as possible; but it was not probable that they could obtain the requisite amount of timber, of suitable description, for so large a contract, much, if at all within the time which their contracts admitted; and experience has shown, that we cannot always rely on our locomotive builders, for the delivery of engines within the time specified by their agreements.

These difficulties, it is believed, are now to a great extent overcome. The road between Reading and Mount Carbon, which, from having been laid in the *winter*, was not in as good condition as could be desired, has been greatly improved, and the whole line of track from Mount Carbon to Richmond, and to the Columbia Railroad Bridge, is now in good condition. The bridges throughout the line, have been thoroughly examined, and every thing done which seemed likely to add to their permanency and durability; they are now in good solid condition with the exception of the one across French Creek, at Phœnixville, which, in consequence of the spans being increased beyond what was anticipated at the time of framing it, has proved less permanent than the rest. Such improvements are now being made to it, as will give it the required strength. In rebuilding the bridge across the Falls of Schuylkill, only about one-third was rebuilt on the original plan, the balance being of trusswork, supported by the piers and intermediate trusses. The timber for rebuilding, permanently, this portion of the work, is now being delivered, and will be speedily framed and in readiness to raise, but the present structure will stand any ordinary freshet. During the past summer, the track has been doubled at four suitable points, for a sufficient length to pass *two* of the longest coal trains at each point, affording with the double tracks previously laid, accommodation for the passage of ten or twelve trains per day in each direction. Additional tracks are being laid at Schuylkill Haven and at Richmond, and the trusswork is being built on four additional wharves, so as to afford every facility for speedy shipment. Arrangements are also making for some additional water stations, which will probably be required by the trade of next year, and for increasing the capacity of those already built, by the introduction of constant streams, wherever they can be commanded at any reasonable cost.

There are at present on the road twenty-four engines, (eight of which are calculated for passengers and light freight, and sixteen for coal, etc.,) and eleven hundred and thirty coal cars. The engines are sufficient for a business of six trains or about one thousand tons per day. In addition to these, a contract has been entered into with the Locks and Canals Company of Lowell, Mass., for twelve engines and four hundred and fifty coal cars, which are progressing rapidly, and will probably be delivered in the course of next spring. When this contract has been completed, together with two engines now building, and nearly finished, by the New Castle Manufacturing Company, the force on the road, for the transportation of coal, will be thirty engines and fifteen hundred and eighty cars, equal to about ten trains, or a business of about 1600 tons per day. This, it is thought, will be about as large a business as can well be accommodated, until some continuous portion of the track can be doubled; and it is extremely desirable that this should be done as soon as the arrangements of the Company will admit of it. If a double track was laid between Reading and Pottstown, a distance of eighteen miles, (of which *two* are already laid,) the trains from each end of the line could be passed in this distance, and not only would the capacity of the road be greatly increased, but the delays and irregularities which the best management on a single track cannot al-

ways prevent, would be avoided. The increased number of engines on the road will render it necessary to add to the workshop at Reading in the course of next summer. The present building was erected with a view to its extension whenever the trade on the road should require it.

From the causes mentioned in the beginning of this Report, the coal business done on the road during the past year has been much less than was anticipated, but nothing has occurred at all calculated to shake the opinion formed of its capacity, as to the amount of business that can be done, or the cheapness of transportation over it. The greatest number of coal trains yet passed over the road per day is five in each direction; a small number, it is true, compared with the anticipated trade of next year, but these were all passed at one point (Reading,) and the double track, now laid, will admit of the passage of at least double that number with nearly equal facility. The performance of the engines during the past year leaves no doubt of their being fully equal to their estimated power, their usual loads being from one hundred and sixty to two hundred tons. The experience of the past year also confirms the opinion that the cost of transporting coal from Mount Carbon to Richmond, will not exceed 50 cents per ton; at present it would appear to be less, but allowance is to be made for the cars and engines being new, and requiring less for repairs than they will after having been some time in use.

The amount of the receipts of the road for the year ending 31st December, 1842, as near as can at present be ascertained, are about $200,000, and the expenses for the same period about $118,000. A general and detailed statement of the working of the road, amount of business done, etc., will be made out and presented to the Board, but cannot be completed in time for the meeting of the stockholders.

From the preparations now making in the coal region, and the great demand for the Company's cars during the past year, there is every reason to believe that when the shipping season commences, there will be few, if any, of the unemployed at the rate of freight now charged; should this be the case, 300,000 tons would seem a very safe estimate for the amount of the coal business of next year. The receipts of the road for the past year, from sources other than coal, are about $140,000, and as it is the first year since its opening to Mount Carbon, and has been one of extraordinary depression in all kinds of business, it is probable that the receipts from the same sources for the next year will not be much less than $200,000. Should this estimate of the business of next year be correct, the receipts of the road would be about - - - - - $630,000
Probable expense for the same period, - - - 220,000

Probable nett receipts for 1843, - - - $410,000

A statement of the number of cars, engines, etc., now on the road, and of those contracted for but not yet delivered, is herewith presented.

I have the honor to be,
Gentlemen,
Your ob't. serv't,
WIRT ROBINSON,
Engineer and Gen. Supdt. P. & R. R. R.

December 31st, 1842.

Cost of Transportation on Railroads. By C. Ellet Jr., C. E.

On the value of time.

In estimating the cost of transportation on railroads I have taken no account, in the preceding numbers, of an item which is generally considered of great consequence in determining the result; viz. *the value of time.* Speed is the peculiar advantage of railroads, and one which is certainly sometimes deserving of much consideration in the administration of the work. I propose to estimate its real value, as nearly as it can be done, in the transportation of passengers and merchandize.

First, then, what are we to regard as the measure of the value of time on any article of merchandize? Is it not the interest on the capital invested in the commodity, at the rate at which the proprietor estimates his profits for the time, added to the rate at which his goods depreciate in value in consequence of detention on the route?

If this be true—and I cannot well perceive what other value than this the *time* lost in their conveyance can possess—let us endeavor to ascertain to what it will amount under different circumstances; and for this purpose we will represent by

r the rate of interest, and depreciation of the value of the goods, per cent. per annum;

P the value in dollars of one ton of the commodity; and

V any velocity of transportation in miles per hour.

There are 8760 hours in a year; and if we represent this number by m, the interest and depreciation of the value of a ton of goods, in the space of one hour, will be expressed by

$$\frac{P\,r}{100m};$$

and during the time the goods are carried one mile at the velocity V, it will amount to the sum

$$\frac{P\,r}{100m\,V}.$$

This interest and depreciation, for any other greater velocity V′, will be for the time consumed in traversing one mile

$$\frac{P\,r}{100\,m\,V'};$$

and, consequently, the difference between the values of the two velocities V and V′ (supposing that the time and speed be well employed, and that the engine drivers do not waste at the stations and depots what he gains on the route,) for each ton and for one mile, will be

$$\frac{P\,r}{100m}\left(\frac{V'-V}{V'\,V}\right). \qquad (K)$$

This expression represents the amount which the goods would depreciate while passing over one mile, at the velocity V, over and

above their interest and depreciation while traversing the same distance at the velocity V'; or the additional sum which the owner of the goods would be willing to pay to have them carried at the speed V' instead of the slower rate V.

Now let us apply this equation to the transportation of coal, and assume for the velocity V' that which would be likely to have place on a railroad, or ten miles per hour; and for that of V the ordinary speed of a canal boat, or two and a half miles per hour; for the value of the commodity, *three dollars* per ton, and for the value of the capital employed in the trade, 20 per cent. per annum.

How much per ton per mile would the value of a speed of ten miles per hour exceed that of two and a half miles? By the equation we have here

$$\frac{3 + 20}{8760 \times 100}\left(\frac{10-2.5}{10+2.5}\right) = \frac{1}{48666}\text{of a dollar,}$$

or a fraction more than the fiftieth part of one mill per ton per mile. It would appear, then, if this process be correct, that their is but little encouragement to tear the road, and oars, and engines to pieces—augment the risk of accident, and increase the actual cost of transportation 100 per cent.—for the purpose of delivering coal a few hours sooner than it might be effected on a canal at a speed of two and a half miles per hour. If the value of the coal be not more than three dollars per ton at the mine, and the value of the capital engaged in the trade not more than 20 per cent. per annum, the difference to the proprietor could not amount to more than the *fifth part of one cent per ton for the whole time consumed in traversing a space of* 100 *miles.*

Again, let us suppose that the article is flour, of which the value is six dollars per barrel; and let us, at the same time, assume that the depreciation would be 100 per cent. per annum: which is equivalent to the supposition that it would be entirely destroyed if it were detained one year on the passage, and that the depreciation is uniform during the whole period. We will also suppose that the speed on the railroad is infinitely great, or that a mile might be passed by a locomotive engine in a space of time so short as to be wholly inappreciable; while the speed with which the same article would be transported on a canal is, as usual, two and a half miles per hour.

What is the value of the time lost on the canal in this case? Here we have $r = 100$, $P = 6$, $V' =$ infinite, and $V = 2\frac{1}{2}$; which quantities being substituted in the equation yield

$$\frac{100 \times 6}{8760 + 100}\cdot\frac{1}{2\frac{1}{2}} = \frac{1}{3650}\text{of a dollar,}$$

or about the *fourth part of one mill per mile per barrel.*

This will be recognized as rather an extreme case; but still it does not justify a high speed,—for three mills per ton per mile is generally not very perceptible among the quantities which enter into the aggregate expenses of a railroad line.

Let us next suppose the commodity to be groceries—such, for

instance, as sugar and coffee—of which the value may be assumed at two hundred dollars per ton; and that the interest and depreciation are equal to 20 per cent. per annum. In this case will find for the difference between the value of a speed of ten miles per hour, and one of two and a half miles per hour—between the speed of a locomotive and that of a canal boat,

$$\frac{200 + 20}{8760 + 100}\left(\frac{10-2\frac{1}{2}}{10+2\frac{1}{2}}\right) = \frac{1}{730} \text{ of a dollar,}$$

or about *one and a third mills per ton per mile.* The difference between the value of a speed of five and one of ten miles per hour, would not in this case have exceeded a half mill per ton per mile.

A high speed, then, is not justifiable in the transportation of groceries for the purpose of saving time in the delivery of the freight. If it be adopted at all it must be because the condition of the road, or some other part of the business which it accomodates, renders it imperative, or because the injury which the work sustains in consequence of the greater velocity is not properly appreciated by the parties in control of the line.

We will next take the case of dry goods, of which the average value may, perhaps, be assumed at 2,000 dollars per ton; the interest and depreciation will again be put at 20 per cent., and the respective velocities at two and a half and fifteen miles per hour.

By the formula we have, in this case,

$$\frac{2000 + 20}{8760 + 100}\left(\frac{15-2\frac{1}{2}}{15+2\frac{1}{2}}\right) = \frac{1}{66} \text{ of a dollar,}$$

or one cent and a half per ton per mile.

This sum is nearly equal to the actual cost of transportation on a road in good condition; and it is therefore apparent that in the conveyance of trains composed exclusively of the most valuable goods, a greater velocity than two and a half miles per hour is always proper; but when it is recollected that there is never more than a very small proportion of the merchandize passing over a line, which possesses anything like the value here assumed—2,000 dollars per ton—the adoption of a higher velocity must still be regarded as of very doubtful utility. Even in the case pefore us—where the value of the goods is assumed at 2,000 dollars per ton—the difference between the value of a speed of fifteen miles per hour and one of six miles per hour would not amount to a half cent per ton per mile—a sum which would by no means justify a higher speed even if the train were loaded entirely with such goods.

If we apply the same method of computation to the conveyance of passengers, and estimate the average value of the time of all the individuals in the trains, at twelve cents per hour, we shall have for the difference between the value of a speed of fifteen miles per hour and the usual speed of freight boats on canals, or two and a half miles per hour,

$$12\left(\frac{15-2\frac{1}{2}}{15+2\frac{1}{2}}\right) = 4 \textit{ cents per passenger per mile.}$$

If the average time of all the individuals travelling be worth

twelve cents per hour, the charges on a road where a speed of fifteen miles per hour is adopted, *may be four cents per mile higher than could be demanded on one where a velocity of only two and a half miles per hour is maintained.* Of course there is a great difference between the values put on their time by different individuals; and of course too, there must be much uncertainty in fixing upon a general average. But twelve cents per hour (including the expenses incident to the trip) is by no means a high estimate for the time of all the individuals travelling in the public conveyances; but yet, low as it is, it shows for the value of the time of one person—exclusive of what mere impatience would prompt him to pay—a sum nearly two thousand times greater than that of a ton of coal, thirty times greater than that of a hogshead of sugar, and nearly three times that of a ton of ordinary dry goods, transported at the same rate.

We may perceive, then, why the superiority of railroads is so much greater in the transportation of passengers than of heavy freight; and how it may happen that a velocity which is in the highest degree economical when adopted for the convenience of travellers, may be ruinous when applied to the transportation of minerals and produce. Indeed it is difficult to over-estimate the injury which is inflicted on the interests of stockholders, from the continuance of this evil in the management of railroads, although it has been materially abated within the last four years. The value of the additional time which is consumed at the slower rate is absolutely unworthy of consideration in the conveyance of merchandize; and the only question which ought to occupy the attention of the directory is the reduction of the actual expenses of the line, and the selection of that velocity which corresponds with the greatest possible economy. The great and constant effort should be to reduce the cost of transportation to the lowest limit. It is not railroads nor canals that increase the trade of a country or add wealth to the districts which they traverse. It is the reduction of the charges for conveyance which these improvements permit, from which these great advantages are derived. And high speed on such commodities offers no compensation for the high charges which it axacts.

These considerations are applicable only to the value of time on the goods transported. But the loss of interest, and depreciation of the value of the freight, are not the only losses involved in the adoption of an insufficient speed. The value of the time of the *train, and of the train hands,* is also to be considered, and enters into the complete expression of the actual cost of transportation. If the engines and cars, and the men who conduct them, do less duty than they might accomplish by the adoption of a higher velocity, the value of the time of the increase of stock and force which will be required to effect the same duty at the slower rate, must obviously be charged against that velocity.

It is true that there are cases in which the speed to be adopted is governed by the necessity of accommodating a certain amount of

trade, or making room for a large passenger conveyance, which could not be adequately provided for on a single track, without maintaining a speed determined by the circumstances. Of course the company must submit to this necessity; they must adopt a high velocity where these or other imperative conditions exact it. But the question now is, what is the value of velocity or time, where they have the power to exercise their own discretion in the selection of the speed?

In all such cases the slower the motion of the train the less will be the expenses of the company, unless it be reduced so low that the interest on the cars and engines which convey the freight, and the loss of the time of the engine and train hands, more than compensates for the reduced charges for repairs of the road and machinery.

We will designate by F the value of the locomotive engine in dollars; by f the value of the stock in cars for each ton of freight; by m' the value of time of all the hands in the train for one hour; and by q the number of tons of merchandize in the train.

The value of one hour for the whole train will be, at 6 per cent.

$$\frac{6}{100\,m}(F+fq)+m'; \qquad (L)$$

and if we represent this quantity by H, the difference between the values of the velocity V′ and that of V, will be for each ton, and for one mile

$$\frac{H}{q}\left(\frac{V'-V}{V'V}\right). \qquad (M)$$

This is the difference per ton per mile to the company between the values of these velocities, where no imperative conditions obtain.

Now let us see what value this expression exhibits under different circumstances: and for this purpose we will put $F = 5000$; $f = 100$; $q = 50$; $m = 8760$; $m' = \frac{1}{4}$, all which are very common values, and suppose, in the first instance, that the business of the line may be transacted by an adequate supply of engines, men and cars, at some exceedingly slow rate—as half a mile per hour—how much more would it cost the company, in the value of time, to carry the trade at this rate, than at a speed of ten miles per hour?

Equation (L) gives us

$$H = \frac{11}{40}\text{of a dollar,}$$

for the value of one hour of the time of the train. This value of H being substituted in equation (M) will yield,

$$\frac{11}{40+50}\cdot\frac{10-\frac{1}{2}}{10+\frac{1}{2}}=\frac{209}{20000}\text{of a dollar,}$$

or more than one cent per ton per mile.

Now, in this case, the value of the time of the train, exclusive of the goods, is equal to half the actual cost of transportation on a well managed road with ample trade; and it is perfectly apparent

that, even overlooking the loss of time and depreciation of the price of the *goods*, such a rate is wholly inadmissible. But let us apply the equation to the determination of the difference of value of a speed of five miles and one of ten miles per hour, under the same circumstances. In this case equation (M) gives us

$$\frac{11}{40\times 50}\cdot\frac{10-5}{10+5}=\frac{11}{20000}\text{—of a dollar,}$$

or only one half mill per ton per mile—or less than the tythe of the actual difference of cost—consequent on the destruction of cars, engines and track—risk of accident and damage of goods, incident to the adoption of the greater velocity.

The whole difference between the value of a speed of five miles per hour and one of ten miles per hour, will rarely exceed one mill per ton per mile, in its effect on the interest of the value of the train, together with the depreciation of the value of the goods conveyed. However great, then, may be the inducement to carry passengers at a more rapid rate, there is no sufficient cause for transportating freight at a speed of more than five miles per hour, unless, as already premised, a higher rate is absolutely essential for the accommodation of all the trade which is commanded by the line—a condition which, on ordinary roads in this country, very rarely prevails.

We are not likely to overrate the injurious effect, or too strongly to deprecate the continuance, of the mischievous practice which still prevails in this country in the transportation of heavy commodities. The iron rails are rapidly destroyed by it; the wear and tear of the cars and engines are greatly augmented, and the useful effect of the power applied is materially reduced. There is no corresponding advantage obtained. The value of the time which is saved is almost too small to be estimated for the freight, and the value of the time lost by the train bears no perceptible proportion to the injury which is done to the road and its furniture.

Extract from Address

Delivered at the close of the Twelfth Exhibition of American Manufactures, held by the Franklin Institute of the State of Pennsylvania, for the Promotion of the Mechanic Arts, October, 1842; by A. D. Bache, *LL. D., Prof. of Nat. Philos. and Chem. University of Pennsylvania.*

Prussia has undertaken to show what an "enlightened despotism" may effect, and the results of her combined educational, military, political, and religious system, yet remain to be fully developed. The rulers have had their preferences in regard to the encouragement of different departments of agriculture and the arts. At one time, the silk culture, and the manufacture of silk and porcelain, were especially patronized; at another, brass and iron founding and the culture of the beet, and the manufacture of sugar from it.

The minutiæ to which the government descends, may be perceived from the fact that licenses to follow trades and occupations, the results of which concern human life, (as those of the druggist and chemist, of the architect and builder, of the mason and carpenter, and even of the well-digger,) can only be had upon an examination upon certain preliminary acquisitions, deemed essential to the prosecution of each.

The recommendation of general measures for promoting the interests of the useful arts, is entrusted to a technical commission connected with one of the departments of the government. A society is also permitted in Berlin which takes cognizance of inventions submitted to it, which meets at stated times to discuss reports upon alleged inventions or improvements, and under the nominal patronage of which a monthly journal is published. To provide for the technical instruction of those who intend to follow mechanical employments, schools have been established in many of the provinces, to be entered after the usual period of elementary instruction is passed, and before an apprenticeship is commenced, or during its first years. The most promising pupils of these schools are transferred, after serving a portion of the time of their apprenticeship, to a central school, at Berlin, where they receive, free of expense, instruction in the branches which may fit them for the occupation of machinists, founders, and the like. Architects, builders, and engineers, have a similar public institution, for the preparation of the members of their professions. The Trade Institute of Berlin turns out annually a class of well educated young men, whose influence on the occupations which they embrace, must ultimately be of the highest benefit.

The plan and execution of that great scheme of uniting the States of Germany, once loosely connected by political ties, in a commercial league, is due to Prussia, and now the toll-league embraces nearly all the States of the old German empire, except Austria. A uniform scale of duties is adopted by all, and import duties are collected at the frontiers, to be distributed in proportions agreed upon by the several parties.

Austria has *her* way of encouraging manufactures and the mechanic arts, different from that of Prussia. Her manufactures of porcelain, of iron, of linen, of sugar, and of chemical products have in turn been aided. Her quicksilver mines and porcelain manufactory belong to the government, and the former are worked by a corps specially organized for the purpose. The government has established trade schools, like those of Berlin, in some of the provinces, but their great *Polytechnic Institution* is in the capital itself. No expense has been spared to collect in this establishment the best specimens of the materials used in the arts, of the tools and machines (or models of them) employed in the different manufactures, and of the products of industry. All are used for the purposes of instruction in the technical schools, and are accessible to the mechanic. One portion of the immense structure is occupied by the rooms devoted to these collections, and to models of architecture of various

kinds and of different countries. In one of them is a model of that admirable structure, now lost to us, the work of an American mechanic, the wooden bridge at Fairmount; and it would be curious if one day a Philadelphian should bring back a copy of it, to place in the hall of the Franklin Institute of Philadelphia.

The late emperor, when heir apparent, vieing with that department of the government which had charge of the polytechnic school, collected for himself a vast museum of materials and products of the arts, presenting not only the results of Austria, but of the world—a standing exhibition of the works of the useful and decorative arts.

The stranger must be struck with the magnificence of the pile thus reared by imperial munificence, as the temple of the useful arts—and as entering the spacious gates, he passes through the halls devoted to elementary instruction in science and languages, to the higher branches of practical science, through the laboratories only rivalled by one among ourselves, through the extensive range of rooms for the display of the materials of the arts, of models, of fabrics, of machines—through the work-shop, whence some of the most accurate instruments have proceeded—through the immense galleries, devoted to a standing exhibition of the arts, manufactures, and agriculture of Austria—he cannot but admit that in *this* at least the government has wisely appropriated the means derived from the people for the people's good.

It is admitted by all, that in the arts depending upon chemistry the existence of that institution has already produced important effects, and it is generally believed that the view there afforded of the comparative essays of different manufactures has led to the improvement which the products of Austrian industry have exhibited at the German fairs.

Whether practical instruction in the workshop should precede or follow the theoretical instruction of the schools, is a moot-point. An intelligent iron master of Styria thought he had found the true solution to the problem, by bringing up his sons, from the time of finishing their elementary education, at the forge and furnace, and at the end of their apprenticeship sending them to the technical schools. On the contrary, the Prussian educates for the workshop in the school, requiring each pupil to go through a course of practice there—and in Dresden, the apprentices who are pupils of the Saxon Trade School, work during a part of the day, and receive their technical instruction during the remainder, thus mixing theory with practice

We may admire the efforts of the Austrian and Prussian commission, but after all, the plodding spirit of routine which clogs the limbs of activity in these countries, renders the measures of success of the plans *there*, no scale to judge of what would be accomplished where the load of despotism was not to be borne forward.

France has halted in her scientific career since the youth of the nation have drunk so deeply of the excitements of political life. In Paris, the periodical exhibitions of the manufactures of the kingdom

are doubtless not without their influence. The Conservatory of Arts and Trades—a fine array of models and machines—chronicles the various improvements in each branch of art. The lectures of its eminent professors spread before the student the scientific principles which he is to use. A few members in the National Institute give a representation to the arts. But these are acquisitions of a past day. The trifling public aid extended to the School of Arts and Trades in Paris—the stationary condition of the Sevres porcelain factory—the diminished glory of the Gobelins—the attacks in the Chamber of Deputies upon the Industrial School of Chalons—do not speak of progress in the old way of government support, and no new one has come into operation to replace it.

It would be easier to generalize in regard to the United States, extending as it does through twenty-six degrees of latitude and eighty-three of longitude, than in relation to the small territory of GREAT BRITAIN. If an Englishman's house is his castle, his workshop is its citadel. The establishment of Bolton & Watt is not open even to strangers, and strangers may pass into many not accessible to townsmen. Keen competition keeps men much asunder.

The Manchester man would care little for an exhibition which would bring to his town the iron of Glasgow, or the cutlery of Sheffield. Besides, neither his customers nor his judges are to be found at home. Rodgers displays his cutlery in his shop, because all great manufacturers have a show room; but he looks to America for his gains, and his agent in London occupies a small shop in an obscure street. Mackintosh cares little whether the colors of his dyes suit the "Glasgow folks" or the "Edinboro' gentry" or not, and Strutt does not make his woolens for the consumption of Derby.

The home market is comparatively of little importance. Every man endeavours to improve as fast as he can, to surpass his neighbor—to keep, as far as he can, the ascendency which skill, or talent, or capital may have given him. The attempt of the British Association at Newcastle to bring together the products of the arts and manufactures, was but very partially successful, and it was thought that if this had been made by practical instead of scientific men, it would have failed entirely.

Are we to infer from this, that exhibitions and collections in the arts, and the diffusion of knowledge in regard to them, are all useless? England is the workshop of the world. To what purpose do we toil to promote that which can and will take care of itself? Let us examine this argument a little. Are we sure that things might not be better under a different system, even in England? Who shall say what progress the English manufacturers and mechanics might have made, had their energy been aided by greater publicity—by greater facilities for comparison? One thing may positively be affirmed, that no patriot would exchange the neglect of education on the part of many of their opulent mechanics and manufacturers, of self-improvement out of the immediate line of the workshop, of good manners, and address, for the striking reverse trait

which obtains among so many of our men of equal resources in the arts. Education make a mechanic! says the objector. Watt was educated a surveyor—Arkwright a barber—and yet the one was the great inventor of the useful form of the steam engine, and the other of the jenny. What use of schools for special instruction in mechanics? This objection might, perhaps, have some force, if all men were Watts and Arkwrights, if there were no *common* minds to train. It would have more force if there were no education but to make certain forms of letters, and to construct sentences and to add numbers. Away with such limited views of education! Were Watt's powers of observation and reflection not educated? Were Arkwright's powers of invention not educated? Their lives show how *the circumstances in which they were placed educated* them for their very inventions.

But if this argument is worth any thing, it is worth carrying to its full consequence. Because Burnet was brought up a blacksmith Lukens a farmer, Baldwin a jeweler, Merrick a merchant, and Merris a druggist, we should make linguists by putting our sons to the anvil, mechanicians by requiring them to follow the plough, builders of locomotives and steam engines and machine makers by apprenticing them to the details of filagree work, of accounts, or of pharmacy. This seems the ligitimate inference from the argument of those who, because English manufacturers and mechanics are great in their lines, would eschew schools, lectures, cabinets and exhibitions. Ask the men themselves whom I have referred to, how *they* would desire to educate *their* sons—how they would wish to have been educated, were their lives to be passed over again. Hear from them the difficulties which they have encountered for want of a different schooling. Hear from them the circumstances which have really given them their schooling. The school of life and practice is one of the hardest in which men are educated. Men who are educated in it are planting in growing time, and may be considered happy indeed if they reap before winter.

But have no attempts been made in Britain to improve the mechanic as an intellectual being? Professor Anderson, of the Glasgow University, dissatisfied with the narrow regulations which constrained the institution to which he belonged, left by will his apparatus and a small legacy to found a more liberal school. Dr. Birkbeck endeavored to make this small foundation available for the instruction of mechanics, and classes were opened for their benefit in the institution. Voluntary associations of mechanics, under various titles, sprung up under the direction of Birkbeck and his associates, and for a time promised great things in the culture of both the adult and the youthful mind. They usually combined public lectures in chemical, mechanical, and general science, and classes of mathematics, of English, modern languages, etc., for the sons, wards, and apprentices of members. Many of them are still in existence. Some have taken root, but are found to be supported more generally by merchants of various grades than by mechanics. From the example of these associations, others for very pop-

ular instruction have been established, giving lectures at moderate rates on geography, history, and the elements of natural science.

Some of the institutions for the promotion of the arts award prizes for special excellence in particular objects to manufacturers and mechanics, and also to the successful pupils of their schools. The Society of Arts of London, and that of Scotland, give premiums for meritorious inventions submitted to them; have papers read before them, by members, on new inventions, and the former association publishes its transactions. Each has a meeting for the public award of premiums. The Royal Institution of London, at its Friday evening meetings, calls frequently on mechanics for lectures, explaining their arts and trades, and the improvements in them. These and similar efforts contribute to diffuse and to increase knowledge. If the results seem to be small, lost in the great stream of improvement which ever flows onward; yet in mingling with it, they impart at least some small motion to its mighty mass. The collision of mind with mind that takes place in these numerous associations, is of high importance; the tendency is to make men aware of their own deficiences and to furnish a motive to supply them, to liberalize the feelings, to promote mutual confidence, and to produce esprit de corps. The results are of inestimable value in the aggregate.

The low wages of operatives generally in Europe, low relatively to the prices of conveniences, tends to keep the mass of them from intellectual improvement. Their youth is passed before they can judge of the necessity for culture, and when manhood is reached, the cares of providing food and maintenance for themselves, and usually for a family besides, press upon them so heavily, that they have time to think of little else. Until the means of life are more uniformly distributed, the mass of the mechanical population of Europe cannot become intellectual. The advantages of a different system of things, which exists with us, we should never lose sight of—never let go. It is not true that the necessaries and comforts of life are higher with us in the same proportion as our wages. The life of the American working-men is not that of the European. Besides that his inestimable political rights put him on a par as a citizen with every other citizen, he occupies a different place in the social scale—may, by education in school and out of school, put himself on an equality with any other citizen—and may have comfort and competence for himself and family. Thus relieved from the grinding pressure of want, wo to him if he slight the privileges bestowed by a bountiful Providence! Wo to him if he forget that he has a mind and soul as well as a body—an intellectual and moral as well as a physical nature!

Which of all these plans, devised by the intelligence of so many minds, for the *improvement of the useful arts, and their cultivators*, have we followed out? What new paths have we opened? What success has attended our exertions? Voluntary associations for the improvement of agriculture, manufactures, and the arts, exist all over our country, not supported, it is true by our great sovereign,

the people, but by a few, who are either immediately or remotely interested or who desire to advance the weal of their country. If the eyes of this most august sovereign might but be opened to the importance of fostering these institutions! If for the improvement of the mass, he would but contribute a little of what he lavishes in raising up the political princes of the land! In the olden time. the commons of England gave every ninth sheep and every ninth fleece, to their ruler, to enable him to wage war; now a large portion of our commons devote at least the ninth penny to king Party, to enable him to carry on the strife political. Would that they would spare the ninth part of this to put down ignorance and elevate virtue.

In different parts of our country, the modes of action intended to accomplish the great ends to which I have referred, have been various, and attended with very different degrees of success. It will be more proper, as well as more profitable, to look specially to our own doings.

TO BE CONTINUED.

SELECTIONS FROM FOREIGN JOURNALS.

Eruption of Mount Etna.—This Volcano after a rest of several years has again given signs of great internal commotion. In November the usual prognostics, the drying up of the springs, and the smoke, gave an intimation of what was about to take place. The flames were seen at Palermo, a distance of ninety miles in a direct line. No lava has yet been thrown out.

Novel Artesian Well.—An experiment is now making at the head of the Brighton chain pier, by which it is intended to obtain fresh water from below the ocean. It is expected that at the depth of seventy feet the chalk formation will be reached and fresh water obtained.

Keene's Marble Cement.—This is a combination of plaster of Paris (Sulphate of Lime) and alum. Common *boiled* plaster is steeped in a saturated solution of alum and then re-calcined and reduced to powder when it is fit for use. Although not capable of standing weather this substance is now attracting much notice from the beautiful stucco which it forms, resembling marble. It may be colored by simply mixing the color with the water used in applying it. The hardness of the substance and its beautiful polish, have brought it into use for interior decoration.

The Great Northern Steamer.—This vessel built at Londonderry is upwards of 1500 tons burthen and is fitted with Smith's Screw propellers, driven by engines of 350 horse power. She is rigged in all respects like ordinary vessels of similar size, and the steam power is considered as merely an axiliary to be used in calms, head winds etc. This mode of using steam upon the ocean, seems destined to become far more general and for most purposes more economical than the use of steam vessels as generally built.

AMERICAN

RAILROAD JOURNAL,

AND

MECHANICS' MAGAZINE.

No. 2, Vol. X. New Series.] FEBRUARY, 1843. [Whole No. 482 Vol. XVI.

We are again indebted to Mr. Jos. E. Bloomfield for an analysis of the annual return of the Massachusetts Railroads.

This is the sixth year for which these tables have been made, and each is of increasing interest as containing the result of more experience.

For the American Railroad Journal and Mechanics' Magazine.]

In presenting you with the 6th table of the annual receipts, expenses, dividends, and cost, of the railways completed in Massachusetts, compiled from the reports of the several railroad companies, for the last six years, to the Legislature, it is to be regretted there are so few new features to remark on. They have pursued a legal form in their returns, without reference to detail, and the working of their roads. The reports however of the *Western railroad—Eastern railroad*, and *Norwich and Worcester railroads*, give us tabular details, highly interesting. The cost, and *working of* the Western railroad, is placed under the several heads, so repeatedly asked for in your valuable Journal.—Their publication, and the form of the table of the superintendents department of the Norwich railroad are models for imitation.

It will be perceived, the cost of the Western railroad to Albany from Worcester, is $7,566,791 for 156 miles of road—with 14 miles of turnout—equal to $48,500 cost per mile.—The Boston and Worcester railroad 44¼ miles, has cost $2,726,102.—Total cost of 200 miles of road $10,292,893. On this road, there were great deficulties to conquer, from the nature of the ground, runing as the line

does, at right angles, with rocky, mountain summits.—One is east of the Conneticut river, at Carlton, 906 feet above the *base* line of the Boston and Worcester railroad in Boston, the other, at Mount Washington, between the Conneticut and Hudson Rivers 1456 feet along the same base line at Boston mill dam and 1480 feet above tide water.

The desire to press forward a large expenditure, to accomplish the wish of the statesmen, who planed this magnificient work, has caused many extra expenses. This is perceived in the cost of depots, and of land for the *right* of *way*. Also in the item of engineering, amounting as it does to $263,105 or near $1700 per mile. The item of land damages, with depots and Stations, consisting of 1648 acres of which 118 acres are for 29 depots, has cost $339,716, exceeding $200 per acre, for 10½ acres to the mile.

This land, for farming purposes, cannot be valued on an average, to exceed $50 per acre. It has been greatly exchanged in value, by this road, affording a ready market for agricultural and manufactured products, yet we find, that the location, prior to the obtaining of releases, or terms, and hot haste with which the work has been forced through, has cost the company $2163 per mile, for "depots, and the right of way,"—although it was considered, at the commencement of the work, that ample grounds had been taken for depots at Springfield and other points, yet the report states "they were found insufficient." At Greenbush, in front of Albany, twenty-one acres of land with 1600 feet of front on the Hudson River, have been secured, and a canal excavated along side of a Brick ware house 420 feet by 90 feet, with other commodious buildings, and wood sheds. Thus in order to manage with economy the business that will naturally be drawn to this important avenue from the grain and provisions districts of this state, to manufacturing New England and her web of railways.

The results, the first year, after the completion of the Western road to Albany, speaks much for this work. With a deficient *motive power*, in proportion to the business offered,—also with 15 miles of the Hudson and Berkshire railroad, an inferior road, and expensive to operate, until their road was completed, the following receipts must cause surprise even to its friends. It is an earnest of the business "the directors look forward to this year" *on the opening of our Canal.*

They have received for 18,570 *through*, and 271,866 *way* PASSENGERS (the receipts from the way being nearly as on 1½ to 1, or $178,566 way, to $92,850 through) the sum of $266,446.

There were 6,211,971 tons *nett*, transported one mile, equal to 39,820 tons carried over the whole road, 156 miles, or, equal to 1026, through trips with 38¾ tons per trip, this amount is about half the capacity of the freight engines, over grades of 83 feet.

There were sent from the Greenbush station, Eastward 170,615.

Barrels of flour, weighing	18,341 Tons		
Beef, Pork, Butter Cheese etc.	12,347 "		
Tons	30,688 "		
Tonnage from Boston and other places going West	9,132	producing	$246,242
Total freight and passengers,			$512,688

The expenses of this business (which includes $48,992 for repairs to the road, and to keep the same in permanent condition) is 52 per cent of the receipts, $256,619

This rate is moderate, compared with the commencement of other roads in New England. The Locomotives on this road, have run 397,295 miles at an expense of only 67 cents per mile. This result, with such heavy grades, and with the difficulties they have had to overcome, attendant on a new work, reflects great credit on the Directors and agents, and gives, as they truly say, "great promise for the future."

There is another and striking view, of the amount of receipts over the Western railroad, compared with the receipts of tolls on our Erie and Champlain Canals after their completion.

The comparative cost and receipts of tolls, the first year after the completion of those works, 450 miles in length with their feeders, is as follows:—

The cost of the Boston and Worcester railroad	44½ miles,			$2,726,102
The Western railroad,	117 "	$5,814,807		
The Albany and West Stockbridge,	38½ "	1,751,994		7,566,701
Boston to Albany,	200	miles, cost		$10,292,803
The cost of the Erie and Champlain Canals	450	miles, was within		$8,000,000

The entire receipts from *Freight* and *Passengers* 1842 over the Bost. Worcester	$175,674	$186,610	
The Western & Albany	$246,242	$266,446	$874,961
The tolls the *first* year, after the completion of the Erie and Champlain Canals, were - - -			$566,12

The fourth year, the tolls were $795,056. The expenses for repairs, agents and collectors have averaged about $1000 to 1200 per mile per annum on the New York Canals.

It is understood that Massachusetts has about $22,000,000 invested in railway stock in that State. The railroad investments in Rhode Island, Maine, New Hampshire and Conneticut equal $5,000,000 additional.

It has been represented that Boston owns half of the stock in the line of railways, from her state line to Buffalo, a distance of 364 miles. The cost of this line may be estimated at $20,000 per mile or $7,200,000.—New England therefore has $31,000,000.—judiciously, invested, producing on an average of 6 per cent, per ann. after ample allowances for renewals, steadily improving.

This view is warranted, on examing the result of the average income, for the last six years of the three first constructed railways, radiating from Boston. These roads are too short for economy in their management. They were built in 1832-3-4 a period when labor was very high. They could now be constructed for about half what they then cost.

	Length	Cost	Expenses for 6 years	Receipts for 6 years	Dividends 6 years	Average for 6 years
Boston and Lowell	26	1,834,893	588,127	1,391,196	46 p.c.	7,66
Boston and Providence	41	1,782,000	847,852	1,499,794	42 "	7
Boston and Worcester	44	2,374,547	778,666	1,594,825	41 "	6,86
Miles,	111	6,990440	2,214,645	$4,485,815	Average	7,16

The several railroads from the Hudson to Buffalo in this state, yields from 6 to 12 per cent., with the exception of the Mohawk and Hudson railroad.

The Canals first constructed in New England, have comparatively all gone into disuse. This will be the case with the latteral Canals, in this state, on the introduction of good railways. The Erie canal from its peculiar location, connecting inland seas, with the Sea Board, on a remarkable throughfare, will be an exception. The policy of enlarging this work, is beginning to be questioned, even in the Western district through which it passes. The *glory* of the undertaking, heretofore carried the Eastern, and Western counties in favor of the project, without due consideration, any correct estimate of its cost, or its use, to cheapen transportation, when completed.

It may reasonably be expected, that the farmers and traders of our own state, who witness the success of Massachusetts, in carrying all classes of *bulky produce*, at from 2 to 5 cents per ton per mile, and Passengers, at from 1 to 2½ cents per mile, will not permit *the state to monopolize transportation*, for only seven months in the year, —thus excluding them from the seaboard market for provisions in the winter,—the best, both at home and abroad. This too, at a period, when for pleasure, and with profit, the farmer can attend to his own sales, and purchases. If our state restriction on railways to carry freight is taken off, every month in the year, will be a business month.

A smaller capital will enable the merchant and trader, to do a a *safer*, more *certain*, and more profitable business, than formerly.

The system of railways, marked out from New Orleans to Portland in Maine, and the actual completion of a continuous line of 640 miles of road from Portland, to Buffalo on Lake Erie, will when extended, through Ohio to St. Louis, prove the best regulator of domestic exchanges. Railroads are destined to equalize the value of the currency, at all points of the Union. As a means of defence, they require the fostering care of the War Department, and patronage of the Post Office department.

In closing these remarks, which I have been obliged to run off hastily for this number of your Journal, it is proper I should mention, that since the last report, the Boston and Lowell, and Lowell and Nashua railroads, have been extended to Concord in New Hampshire. The Berkeshire railroad, 21 miles from the Housatonic railroad, at the Massachusetts South line, has been completed to Stockbridge, and *put in operation*, for the moderate sum of $205,000. The Eastern railroad, has been continued from Portsmouth to Portland, during the last year, while the construction of the line in Connecticut from Hartford to Springfield, 25 miles, has been secured, thus proving that the march of the railway cause, in *calculating New England*, where the extra sagacity of the people is proverbial, is onward.

The fate of the Farmington, the Blackstone and the Middlesex canals, should be a beacon to deter us in this state, from the construction of any more latteral canals. We should profit by the eloquent, and true passage, taken from a report to the Legislature of Massachusetts in 1839, made by a select committee, when having under consideration, aid to the Western railroad.

The report states, "Railways have universally created the means of their own sustenance, and have drawn to their tracks, employment for their motion. If the beneficence of Providence, had hollowed a channel from Boston to the Western Lakes, and poured the floods of those inland seas, eastward to the Ocean, the blessings would have been too great for sufficient gratitude, as they would have been beyond all computation. The river, swelled by tributary streams, from every valley, would have scattered wealth along its course. For all practical purposes, the invention of art, bestows better advantages, and furnishes communication made more easy and certain, than the bounty of nature could give. During the stern winter of our climate, the rivers are closed one third of the year with ice, in summer they are exhausted for nearly an equal period; their navigation is bounded by the hills that supply their fountains. The railway is neither locked by cold, nor dried up by heat, nor confined by ridges,—streching out its arms to every town and village, it may be extended beyond the highland barriers of water passage, and beyond the Lakes, until its iron bands clasp together in a net work of improvement, overspreading the whole Union."

Very Respectfully,

JOSEPH E. BLOOMFIELD.

TABLE

Of the Cost, Receipts, Expenses, Income, and Dividends of the Railroads in Massachusetts, compiled from the Annual Reports to the Legislature, of January, 1843, made by the several Corporations, under oath. Also, a Comparative View of the Dividends, Expenses, and Receipts of the Boston and Lowell, the Boston and Providence, and the Boston and Worcester Railroads, for the years 1837, 1838, 1839, 1840, 1841, and 1842, inclusive; and of the Nashua and Lowell, and Taunton Railroads, for four years. Prepared, by request, for the "Railroad Journal," by JOSEPH E. BLOOMFIELD.

NAME OF ROAD.	Date.	Length.	Expended in cost of road.	Rep'rs of engines and cars.	Rep'rs of road.	Rep'rs en'gs & cars per mile.	Rep'rs of road per mile.	Fuel, oil, salaries, and incidental expens's.	Total expenses.	Total receipts.	Income from passengers.	Income from freight and the mail.	Dividends per ann.	Miles run.	Cost per mile run ex. of interest on capital.	Maximum grade.	
Boston and Maine	1842	58	1,260 286	8,169	8,693	141	150	35,099	79,278	155,880	109,681	46,199	6	152,454	52 cts.		
Boston and Lowell	1837			16,633	14,056	650	546	33,424	78,508	180,770	117,643	63,137	7				
do do	1838			10,945	15,734	421	611	48,917	75,597	191,780	109,053	82,697	7				
do do	1839			14,384	18,843	636	731	56,923	92,161	241,220	135,037	106,131	8				
do do	1840			14,455	21,013	561	816	55,932	91,400	231,575	127,008	104,567	8				
do do	1841			22,644	33,193	870	1,200	63,631	119,469	267,541	145,953	121,588	8	125,300	81 1-4	10	Double track.
do do	1842	25¾	1,978,286	28,816	34,972	1119	1,350	67,223	131,012	278,310	148,042	130,269	8	143,607	83 cts.		
Boston and Providence	1837			29,794	11,707	726	285	114,737	156,238	250,882	193,469	57,413	8				
do do	1838			19,953	16,856	486	411	83,234	120,044	265,114	196,974	68,140	8				
do do	1839			19,467	8,604	474	209	65,491	93,562	313,907	234,237	79,670	8				
do do	1840			16,765	13,281	409	334	78,413	143,127	202,601	134,651	67,949	7				
do do	1841			12,722	24,474	309	597	84,857	122,057	230,821	152,015	78,806	7	107,638	93 cts.	37 1-2	Double in part.
do do	1842	41	1,892,831	135,06	21,082	330	514	78,236	112,824	236,469	163,788	72,686	6	132,229	85 1-3		
Boston and Worcester	1837			20,053	9,185	450	206	65,524	94,762	210,047	123,331	86,716	7 1-2				
do do	1838			15,672	12,521	359	281	42,534	85,572	212,324	112,032	100,292	7 1-2				
do do	1839			25,198	18,035	564	405	83,151	126,384	231,807	122,496	109,311	6				
do do	1840			15,667	40,731	374	930	83,043	140,441	267,847	170,855	96,992	6				
do do	1841			27,584	34,949	620	784	100,514	162,998	310,397	190,097	110,001	7	175,000	93 cts.	42	Double in part.
do do	1842	44½	2,726,102	19,073	41,457	426	903	107,979	168,509	362,293	186,610	175,674	7	241,319	70 "		
Nashua and Lowell	1839			2,273	3,980	156	272	23,663	29,985	55,063	36,647	18,406	6 1-2				
do do	1840			4,736	3,447	332	248	24,763	52,583	82,638	35,794	46,849	7 1-2				

TABLE Continued.

NAME OF ROAD.	Date.	Length.	Expended in cost of road.	Rep'rs of engines and cars.	Rep'rs of road.	Rep'rs en'gs & cars per mile.	Rep'rs of road per mile.	Fuel, oil, salaries and incidental expens's.	Total expenses.	Total receipts.	Income from passengers.	Income from freight and the mail.	Dividends per cent.	Miles run.	Cost per mile run ex. of interest on capital.	Maximum grade.	
Nashua and Lowell	1841			8,263	3,149	589	226	84,553	95,966	132,496	75,732	56,764	8			10	Double track.
do do	1842	14	380,000	7,159	4,339	511	319	32,323	43,826	131,188	66,305	64,883	8	44,040	99½ cts.		
Eastern incomplete	1839			8,563	6,527	914	163	38,048	53,174	125,623	113,068	12,564	5				
do do	1840			12,916	7,909	616	316	64,968	86,793	183,296	164,971	18,326	5				
do do	1841			17,620	31,117	309	520	94,381	154,958	299,674	257,734	41,640	6	191,900	81 "		Single track.
do do	1842	55	2,267,000	14,774	14,786	261	261	89,679	119,039	269,169	237,023	32,145	6	184,127	64 "		
Taunton Branch	1839			3,152	1,397	287	127	36,161	40,711	58,018	40,910	17,108	7				
do do	1840			1,714	2,609	156	237	40,348	44,671	75,477	44,900	30,577	6				
do do	1841			2,253	1,878	205	170	50,912	55,043	76,925	52,279	24,646	7½	20,816	98 "		"
do do	1842	11	250,000	3,419	3,558	220	323	12,088	38,065	77,170	55,711	21,459	8	21,925	133 "		
New Bedford and Taunton	1840			1,318	2,566	120	233	9,162	13,020	26,437	23,250	3,186	6	27,039	82 "		"
do do	1841			3,654	3,416	325	302	15,215	22,285	52,513	39,469	13,044	6	40,734	57 "		
do do	1842	21	426,122	4,418	3,441	210	164	15,496	23,355	55,775	48,483	12,282	6				
Norwich and Worcester	1840								52,503	116,617	78,900	37,617	6				
do do	1841			7,721	6,332	119	108	64,752	78,805	155,261	102,667	52,594	6			22	"
do do	1842	58½	2,158,562	6,289	10,289	132	161	45,501	62,071	112,347	70,821	41,526					
Western	1840			9,618	6,830	164	117	58,746	75,274	157,368	84,343	79,015		144,881	52 "		"
do	1841			16,979	20,207	146	577	67,619	104,806	182,308	113,841	68,467		160,100	65½ "		"
do	1842	117	5,814,807	37,921	48,989	324	418	179,708	266,619	512,688	266,446	246,242		397,295	67 "	83	"
Albany & W. Stockbridge	1842	38½	1,751,084														"
Berkshire	1842	21	205.000														"
Charleston Branch	1842	6	223,144	143	156	24	26	5,890	6,190	12,714	6,168	6,546	3	11,433	54 "	31	"

Notes.—It would appear that the several roads, have generally diminished their expenses proportionate to their receipts, with the exception of the *Boston and Lowell* and the *Boston and Worcester* railroads, both of these roads have taken up parts of the flat rail of 36 lbs., and have substituted a heavy T rail of 56 lbs. The former 20, the latter 12 miles.

The *Boston and Providence* took up 20,329 sleepers and substituted new—the same number will be laid down the next year when the repairs to road it is estimated will not exceed say $12,000 per annum.

The *Lowell and Nashua*, paid $47,744 for the use of the Boston and Lowell railroad,—not included in the above account of expenses of operating the road per mile.

The *Fitchburgh railroad* has just been commenced.

The expense per mile of operating the *Boston and Worcester* railroad, and the *Eastern* railroad, (with an increase of business) has been diminished. The latter carried 468,703 passengers at low fares. A new depot cost $10,081. The total cost of the above thirteen roads to 1 Jan. 1843 is $21,184,123.—The cost of the other roads not enumerated, in Conneticut, Rhode Island, New Hampshire and Maine may safely be estimated, in the absence of returnes at $5 to 6,000,000.

Estimated cost of Railroads in New England $27,000,000.

Examination of the Railroad system.

No. IV.

As suplementary to the subject of Financial difficulties we may notice a topic which should properly have been treated in our last article. We refer to

The high price paid for land on our Railroads generally. This is another of those evils attendant upon the times of speculation, coincident with the construction of most of the Railroads in this country. As a general rule we cannot be far from the truth in saying that the prices paid for land were more than double what would now be gladly received by the same individuals for the same property. The sums then charged for Railroad right of way were however always above the current prices for land and were intended to cover the so called *damages* sustained by proprietors, while at the same time that extravagant compensation for unreal damages, was allowed, no offset was permitted to be made for any advantages or benefit to be derived from the road.

A few notorious instances may be given of absurd charges which were made.

When the land taken by one of our main lines of road was appraised, it was given in evidence by one person that if a certain piece of ground of about 30 acres, of which *one* only was taken by the company, were entirely paid for at current prices, and the 29 acres remaining presented to him as a free gift he would not take it. We believe that suggestion of the Chancellor that this was a proper subject for an indictment for perjury was not acted upon.

It is also well known that individuals in very many cases having purchased lands in prospect of improvement by the Railroad have charged for damages as much money as the land originally cost. It is a fact too that persons have purchased on speculation the land through which a projected Railroad was to pass, with the express object of recovering damages.

After reading these and similar instances we need not be surprised to find that no inconsiderable portion of the original cost of many Railroads was expended upon the land alone.

Having thus briefly and in a general manner examined the most remarkable causes which have individually or together operated disadvantageously upon various works, previous to, and during their construction—we have yet a few words to say upon the

Management of Railroads when completed. This is a very extensive field for investigation and might profitably employ the time of any one devoting himself to the subject. Our design at present is merely to notice a few of the more remarkable errors and difficulties attendant upon Railroad management.

The general principles never to be lost sight of are *The maximum of traffic and the minimum of expense.* No saving is profitable that curtails business, and no expenditure is wise, that does not increase it. Railroad companies are not to be regarded as mere monopolies, enriching themselves at the cost of the community—nor as great philanthrophies impoverishing themselves to benefit the public—but

public accommodation and the profit of the company are alike to be regarded.

When Railroads were first used the accommodation afforded, when compared with other modes of conveyance, was certainly but small. Passengers were obliged to repair to certain determined points, few in number, by means of other conveyances—here stage coaches had the advantage—while steamboats sharing in the same disadvantages afforded on the other hand, great room for travellers and a large number of locomotive comforts. But this was soon understood and remedied and now no one mode of travel combines so many advantages and comforts as are attainable by the Railroad system. Similar observations are applicable to the transportation of goods.

But while all this is attainable it is not always attained, and to point out a few of the short comings is our present object.

Some time since we took occasion to insist upon the necessity of a proper professional superintendance (Vol. VII p. 282.) The machinery and management of a Railroad can only be entrusted with safety to one who thoroughly understands them, and yet unlike all other comparable works, Railroads are often committed to the care of those who really do not understand the tools they use. The only valid objection ever offered to them, has been the expense of obtaining engineers as superintendants. We have shown this to be an error in the article, referred to above, and at the present time professional superintendance can certainly be obtained as cheaply as any other. But granting for a moment that it cost more, it is easy to show that the apparent saving is more than made up in other ways. The whole machinery and the road itself may be gradually going to decay while the comfortable idea of saving money is entertained by the directors and stockholders—a great consumption of power may be daily and hourly taking place—that a little real knowledge would at once detect—in short there are a thousand ways of wasting time, power and money, that none but an engineer could discover—and consequently there are as many opportunities of saving by the exercise of a little professional skill. We believe, however, that our doctrine on this subject is coming daily into more favor—certainly the contrast between roads managed and mismanaged is strikingly evident and the best argument in our side.

The want of a properly organized *police* as it is styled in England is another faithful cause of expense and accident. The great length of road in this country is one cause of the insufficiency of force—but it is not so much the number as the regulation of this force to which we refer. If an accident occurs are the men employed so instructed as to their duties as to be strictly *automatic* that is, does each man in his place know what he is to do—to whom he is to give orders and from whom he is to receive them? Or even are the arrangements and instructions sufficient to prevent accident? We think in many cases a negative answer must be given to both these question. Upon our main lines however great

improvements have been made and are still making—and the great demi-god of our country public opinion has done something, not by pointing out how abuses may be corrected—for that it cannot do (notwithstanding Civil Engineering though it does understand almost every thing) but simply by showing that abuses do exist and leaving it to the good sense of the directors to devise the means of correcting them. The locomotive should be the type for all inferior agents on the Railroad—never leaving the track—always going when started—stopping when checked and ever in full career subject to the power of the brake—or even reversing the motion when required—finally silent when not active. There is but one departure from the analogy they must be civil—get out of the way of others, and not like the locomotive make others get out of their way.

At first high prices were thought to be necessary as a renumeration for the great outlay upon Railroads. This notion is now almost universally discarded, either from the good sense or dearly bought experience of directors. So much improvement in this respect has been made and we have said so much upon the subject of low fares that the subject may be dismissed without further notice, with but one remark. When different classes of cars are maintained the highest class should never be above the means of a large number of travellers, or otherwise an empty car or cars will be the result, and ill will towards the company into the bargain—at the same time all classes should be comfortable, decent and clean. The usages of our country and the good sense of managers will soon bring these things to the proper order.

Punctuality is the cardinal virtue upon Railroads. No expense is extravagant that maintains it, and no line will flourish that does not faithfully observe it.

Finally the comfort and convenience of passengers is to be procured in every possible manner. With them a Railroad defies all competition; without them, every other mode of conveyance will be preferred. The details upon this point are so numerous as to prevent even a notice in a single article. We give below extracts from Lieut. Lecount's Treaties on Railways, which we particularly commend for the spirit in which they are written.

Several of the improvements there suggested have been introduced into this country, others of a similar nature have originated here, but there is room for the more general adoption of such comforts.

We have throughout this subject rather spoken of what ought to be than what has not been. It is sufficient to observe that inattention to these points has been a source of loss to many companies—but as we have already remarked, experience is rapidly suggesting improvement which we hope before long to see carried to an extent which will prove beneficial to the public and profitable to the Railroad Companies.

"Directors of railways out of very large towns, should always bear in mind, that those upon which the public find most accommo-

dation and attention to their wants, will, in the long run, carry away all the pleasure traffic; and there are many things yet requisite in this respect. We may instance the regulations (April 1838) for the London and Birmingham railway, that no person can come into the station to see their friends off by the train. This is positively inhuman, and by what process such an insult to the public can have been allowed to come into operation, we know not. Infancy and age, sickness and imbecility, are alike disregarded; and any one who wishes to see husband or wife, child or friend, to the moment of their departure, has no means of doing so but by taking a ticket to the next station on the line. When a thing is so palpable a monopoly as a railway will in general be, and as that railway in particular is, care should be taken not to show it. On the same railway the charge for dogs is monstrous, namely, ten shillings, which has been exacted even for a lady's lap-dog, carried in a muff. Such regulations as these will drive all those from the railway who are not obliged to travel on absolute business; and with an expenditure of five or six millions, (and another line now in the course of construction will most probably exceed the highest of these sums,) every thing that can be done to procure traffic will be necessary, instead of throwing it away. Dogs are not so often required to be carried, and when they are, should be taken at a reasonable rate, and in proper boxes made for the purpose, not locked up under the seats of the second-class carriages, at the risk of being stifled; and when the owner goes at the same time, no charge whatever should be made.

"If a reasonable time for refreshments cannot be allowed, and if the necessary viands for breakfast and luncheon are not provided at the stations, a refreshment carriage should be fitted up for those who choose to take any, which might very simply be done with a stage in sliding parts to lead to it, or the carriages might be made high enough to walk in, and have a communication from one end to the other of the train, as is done on some of the American railways, the passengers sitting along the sides. This would enable every accommodation to be afforded, including portable water-closets. These American carriages are often 60 feet in length, supported by friction rollers on two four-wheeled trucks, to which they are fixed by central pivots, allowing the wheels to accommodate themselves to the curves; and they are also well warmed with stoves. A smoking carriage might also be fitted up, as this habit has become almost a necessary of life with many people; it should be placed last in the train, except horse boxes and empty private carriages, and no platform should communicate with it, nor any connexion exist with the other carriages."

"What we look to in recommending these accommodations is, the number of persons who would take advantage of them, purely for recreation; and we are convinced that no inconsiderable sum of money would be tured into the cashier's hands at the year's end. Many other conveniences might also be contrived on a similar plan. Carriages might also be reserved entirely for ladies, which would

form no inconsiderable accommodation in many instances; also, for outstations, a first, second, and third-class coach may be made in one carriage. Sick carriages would be another great convenience. These might be fitted up in compartments holding two persons each, that is to say, the invalid and his attendant, with a communication to a compartment containing a portable self-acting water-closet. How many persons under the affliction of severe illness would gladly pay double and triple the usual fares for such accommodations as these, whilst the cost to the railway company would be trifling in the first outlay, and amply repaid again with grateful thanks?

"By the use of the sliding stage along the carriages, and still better, by the before described arrangements in America, all the passengers might be accommodated with access to an apartment containing a portable water-closet, the gentlemen being on the one side and the ladies on the other, and a certain sum being paid for the accommodation, say sixpence, on the fare of each person. No complaint could ever be made of this small charge, and it would amply repay the outlay. Having a means of communication from one carriage to another, is a great desideratum in many respects; and as it is perfectly practicable, it is to be hoped that the march of improvement will not cease till it is obtained. In road travelling, a passenger suddenly taken ill, or from any other cause, has nothing to do but to put his head out of the coach window and make his wants known; the coach can be stopped, and he can receive the necessary assistance. But how different is the case in railway travelling? There, unless he has by accident a seat just under the guard, he might exert his voice in vain, and could by no possibility receive the least help if he was dying; in fact, the more he wanted it, the less able would he be to endeavor to obtain it."

"It may be thought that the number of travelling invalids would be so few as hardly to pay the expense of such carriages as these. Setting aside the want of humanity in such an argument, the public have a right to demand some kind of accommodation in this respect, railways having driven from the roads those long established conveyances in which the passengers could be allowed to stop and administer to the wants of nature when imperative, and replaced them by another system, which, great as are its advantages, is certainly in this instance a deprivation, and liable to be a cause of much bodily suffering. Besides, it is not the number of invalids who are obliged to travel, but the number who would travel, both for business, health, and pleasure, if they could have the means of doing so with safety and convenience. How many would be happy to avail themselves of such a mode of conveyance, at almost any price; whilst for the poorer sort of passengers a cheaper carriage might be constructed, which would answer the desired end at very little more expense than the usual second-class coach."

"As nothing which can minister to the comfort and convenience of the public, ought to be neglected, in the organization of a railway, not only as a payment due from these monopolies to the

community at large, but as the readiest means of their producing a remunerating profit on the enormous outlay which is required for their construction in this country, means should be provided at each terminus where the passengers would be able to obtain every accommodation. In the usual course of things, the termini will generally be at some little distance from the towns, in consequence of the additional expense which would be incurred in the purchase of land, if they were taken to a more central situation. From the continual concourse of people at these termini, new buildings will gradually begin to thicken in that part of the town, and, in a few years, habitations will begin to embrace the railway station on all sides. Inns and shops will be amongst the earliest of these erections; still this will be a work of time, and will little accord with the impulse given to the mind by railway travelling."

"It will therefore be highly advantageous, both to the proprietors of the railways and to the public, if the directors provide for the accommodation of the passengers, simultaneously with the opening of their railway. The expense will be small, and the profit may, with the utmost certainty, be reckoned on as equal to that of any other portion of their property. A building should therefore be erected on a convenient spot, adjacent to the principal stations, which should afford to each class of passengers the means of obtaining refreshments in that manner to which their habits and station in life have accustomed them. Such buildings would admit of considerable architectural display, and, if it should not in any case be thought advisable to include their cost in the general outlay, they may be a separate jointstock speculation, the shares being offered, in the first instance, to the proprietors of the railway shares as was done by the London and Birmingham railway company."

The January number of the Civil Engineer and Architects Journal contains the following letter from a New York correspondent with remarks by the Editor. We give the whole as representing in a fair manner some of the main points at issue between English and American Engineers—and also, as conveying, considering the circumstances, a very handsome compliment to our fellow townsmen Messrs. Stillman & Co.

It does not require any assertion of our own that to convince American Engineers, that the engines of the S. & Co. display more originality and real improvement than the English marine engines which we have had an opportunity of examining in our own waters—for these latter are generally speaking strikingly devoid of any exortifications of the old places.

American Marine Steam Engines.

Sir—A late number of your *Journal* contained some remarks concerning American Marine Steam Engines, which were in a spirit very unlike the usual tone of the English press in descanting upon "Brother Jonathan's" available genius in such matters. Candid, fair, impartial criticism, no matter how close it may chance to "cut," will do much towards removing

those mutual prejudices which unhappily exist to such an extent, that the mere imprint of "American or "English," is oftentimes of itself sufficient to place the merits of any work without the pale of respectful controversy.

This should not be; there is not the least of necessity or of policy in being thus deprived of the benefits of each other's experience; as advantages in some shape or other, most undoubtedly belong to each, and only require to be known in order to be secured. As an illustration, might be adduced the acquaintance already formed through the establishment of your Transatlantic Steam Navigation Companies. One or two instances will suffice. In the English marine engine we see a connecting rod 15 feet long, and 10¼ inches diameter, subjected to the same direct stress with the connecting rod of the American engine, and which is 24 feet long and 6 inches diameter; two thirds *less in area*, and one third *greater in length*, and yet performing equally well the same labor! By this, we are taught, that while the English engines are certainly at *one extreme*, we are probably at the other. Again; the *Great Western*, if you please, comes over here with decks as "clean" as a "man of war," and returns with the singular notion, that on her quarter deck, can be erected, at a trifling expense, a saloon equal in every respect—and superior in many—to the one below, and making an addition to her accommodations equal to one third of all her cabin room below deck!

Notwithstanding the unequalled degree of perfection to which steam navigation upon our rivers has attained—excepting, of course, the great river of the west—the impression is very prevalent abroad, that in the attempt to compete with the "Lion of the seas," we shall be found wanting—an impression unfortunately, most consistent with a certain illegitimate specimen of "Yankee enterprise," which has recently visited your shores. We think however, that the time is not far distant when, with a ship exceeding in length the ordinary proportion, with engines having greater length of stroke so as to admit of working steam at a greater pressure without adding weight to the working parts, with paddle wheels large in diameter, very narrow and making revolutions not less than 20 per minute; and with boilers adapted to a pressure of 15lb., to 20lb., we shall be able somewhat to "shorten the distance" which separates us from the "land of our fathers." Certain it is, that our ship-builders and engineers will not be satisfied with a steamer which will require, for a passage to Liverpool, more than *ten days* of good weather.

You were pleased to notice in a favorable manner the engines of the Spanish steamers *Regent* and *Congress*, built by the late firm of Ward, Stillman & Co., of the Novelty iron works, New York, and to intimate a wish to have the details of their arrangement. In answer to which, I take pleasure in sending to you a detailed account of those vessels, together with so much of a drawing of their engines, as will answer the purpose of your inquiry, and which I am authorized to do by Messrs. Stillman & Co.

Vessels:—	Feet	Inches.
Length on deck	154	0
Breadth	30	8
Ditto at water line	28	8
Depth of hold	14	6
Draft of water	8	6
Burthen	671 tons.	

Frame of white oak, live oak, locust and cedar. The floor of white oak laid close and caulked inside and out. Planked with white oak; fastened

throughout with copper thorough bolts, composition spikes and locust tree-nails.

Engines:—
Diameter of cylinders 42½ inches.
Length of stroke 4 feet 7 inches.
Diameter of paddle wheels 18 feet.
Length of board 7 feet 6 inches, and width 2 feet 6 inches.
Pressure of steam 10lb.
Number of revolutions per minute 26.
Total weight of engines; wheels and boilers 100 tons.
Two copper boilers 22 tons.
Length of boilers 14 feet, height 9 feet, and breadth 8 feet.
Total of fire surface 1400 feet.
Speed of vessel 10 miles per hour.
Cost of vessel, engines and boilers, about 150,000 dollars.

It would be trifling, I fear, with the patience of your readers, to enter into a detailed description of the drawings, representing, as they do—with one or two exceptions—but an "old acquaintance," the "side lever engine;" the principal deviation from which, is the steam valves, and perhaps the air-pump bucket. The valves are shown in the section in the same position as in the drawings you refer to as having received, and which has recently been published in the London *Mechanics' Magazine.* As to the merit of this arrangement of the valves I will not now offer an opinion, except that they are not generally used here for large engines.

As English engineers—either from strict fidelity to the *opinions of Watt* or from much actual *experience*—have held us guilty of divers "barbarisms," in our substitutions for the use of the "slide valve," I shall make this matter the subject of another communication, accompanied with a sketch of the most approved form of the "double" or "balance valve."

The bucket of the air-pump, as shown in the separate sketch, for aught I know, may not be peculiar to this country, nor is it universally adopted here; it has been found, however—in situations where the condensing water is free from sand—to be far more efficient and durable than any other in use.

The "bilge injection," shown near the bottom of the condenser, is here thought to be an essential part of the engine of every steam vessel. And instances have occurred in which the use of it has been attended with the saving of much life and property.

With your permission, I will from time to time furnish your readers with notices—accompanied with drawings—of such improvements in American engineering, as may be thought interesting, or of such of its features as are not familiar to our transatlantic brethren generally.

I am, Sir, &c.,

New York, July 1842. F. W. S.

In our Journal for June last, we noticed that the Spanish government had ordered, and obtained from New York two war steamers, named the "Regent" and "Congress," and in commenting thereon we observed, we wished some further information before we give any opinion on the subject; we were favored with a lithographed external view of the engines, but we desired to look below the surface. Our wish has now been complied with, we are in possession of an apparently perfect section of the engines of the *Regent* and *Congress* steam ships, together with F. W. S's. remarks thereon. and which we now publish. We thank him, and think, if his intentions are supported by engineers of the Old and New World, it

will do much towards the explosion of prejudice, the extension of knowledge, and general good of mankind; that we heartily co-operate in this view we plainly avow, as in fact our remarks in our last December number fully prove. We are, therefore, surprised at the opening paragraph of our correspondent, and we are unconscious of having admitted any thing into our columns which could offend his taste. If we have descanted upon "Brother Jonathan," it was more in playfulness than anger, not as an opposing race, but as descendants of one common stock, to which *genius* is common. We think, however, our correspondent's reprehensions are misapplied, as we do not recollect using the phrase *he* complains of. With this exordium we at once proceed to an analysis and consideration of the engines of the *Regent* and *Congress*.

The engines are of the *beam* kind, and scarcely to be distinguished from those of the *Megera* by Seaward, published by Weale in his Tredgold, pl. 49, vol. 2. The *architecture* is very similar to the engines of the *Tiger*. by Edward Bury. (See Tredgold, vol. 2, plates 110 and 110 a. In one point they differ, in the use of circular valves instead of the D or Murdock slide, and in this it resembles another emanation of American intellect, calledthe *Royal William* (now *Isabella II.*) which made the voyage to England in 1832, and subsequently figured in the Spanish war.

The cylinders are 42½ inches diameter and 4 ft, 7 in. stroke; at 26 strokes or 238 feet the power is equal to 71½ horses each, or 143 horses collectively. This is nominal power as calculated by the rules of the late Mr. Watt, applicable to steam of 2½ or 3 lb. per inch, but in this case we have a pressure on the safety valve of 10 lb. per square inch, so that the *actual* power will probably be 150 per cent. above this, depending entirely upon the expansion used, and we may further observe, that with a suitable arrangement, circular valves may be made to produce any degree of expansion, at pleasure. The air pump is 22 inches diameter, and about 2 ft. 6 in. stroke, = a content of 6·6 cubic feet. Cylinder 42½ in. + 4 ft. 7 in. long = 49·46 feet content, which divided by 6·6, makes the cylinder 7·5 times larger than the pump, just the usual proportions of English engines. The condenser is 2 ft. 5 in. fore and aft, 3 ft. 5 in. in width, and 4 ft. high, with proper deductions is equal to a content of 24 cubic feet, and 71·5 ÷ 24 = nearly 3 cubic per H. P. The circular steam valves are 11½ in. diameter = 103·86 area, the eduction valves are 10 in. diameter = 78·54 area, or rather more than a square inch per horse, a very ample allowance, and much exceeding Mr. Watt's rules, as will be seen by reference to Farey and other works, but taking into consideration the increased density of the steam employed, is judicious. and about on a par with modern *slide* valve practice. Our correspondent is wrong in supposing that English engineers have adhered to the slide valve "from strict fidelity to the opinions of Watt." It is otherwise; they have departed therefrom and followed Murdock, his disciple, who patented the D, triangular, or other shaped sliding valve, in his specification of 1790 (See Farey, p. 677.) We are at a loss, also, to find any novelty in the construction of the circular valves; they appear to us precisely similar to those used by Mr. Watt* in his engines of 1808. He used circular pipes, and here we have rectangular passages (See Farey, plate 20.) We are equally obtuse respecting the air pump, of which we have an isometrical drawing, and can find nothing new therein; if our correspondent alludes to the packing ring similar to that of the piston, we may say that system has been followed in this coun-

* Or rather his successors Boulton and Watt. Mr. Watt retired from business in 1800.

since the year 1826, perhaps earlier. The bilge injection is in the same category.

There is merit in the adaptation of a double beat expansion valve, though it is by no means new and we think we can suggest an improvement as the lower face can never be tight. The other parts of these engines are so much like the best English practice, that it is needless to pursue the inquiry farther. The space occupied in the vessel for each engine is 16 ft. fore and aft, and about 5 ft. 9 in. over the main beams.

On the whole, we think the engines of the *Regent* and *Congress* to be highly creditable to Messrs. Ward, Stillman & Co. of New York, by whom they were manufactured. not only as evincing considerable judgment in detail, but more so, in their selection of the common beam engine, which, after all, appears to be the best kind yet produced.

Extract from Address

Delivered at the close of the Twelfth Exhibition of American Manufactures, held by the Franklin Institute of the State of Pennsylvania, for the Promotion of the Mechanic Arts, October, 1842; by A. D. Bache, *LL. D., Prof. of Nat. Philos. and Chem. University of Pennsylvania.*

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What have *we* done to advance the progress of the useful arts? First, what have been the results of our exhibitions? The same which experience all the world over has shown to result from them. But will it be said by any one, however enthusiastic, that the contrast between the meagre show in the Carpenter's Hall, at our first exhibition, in 1824, and the brilliant display which is just now terminated, is due to these exhibitions, or to those in Philadelphia, New York and Boston, combined? Let us reply by another question. Would we, or would we not, have arrived at the same point without these annual or biennial shows? I answer unhesitatingly, No! It has been remarked of exhibitions of specimens in the arts elsewhere, that though the same artists produce the specimens, there is a steady improvement in them. The taste of the public is improved by them—the taste of the artist is elevated. So, here, observe from year to year the growth in taste of the judges of the different articles submitted at the exhibition, and of the depositors, who are the venders of the manufactured articles. What a powerful reaction must be produced by thus furnishing the vender with the means of accurate comparison, the conclusions from which he may communicate to the manufacturer. Observe the public generally, how the admired articles of one year are the rejected of the next! Listen to the remarks made upon those branches of industry which are stationary. To deal with history instead of what is present; turn to the exhibition of two years ago. Take a branch of manufacture then dead, and compare the effect produced by the well preserved mummies of specimens, though carefully washed and well placed for show, with the results of their first living appear-

ance. The glazing and gilding are untouched, the colors of the painting are as bright as ever, the designs just as tasteful as they were when first exhibited; but the taste of the public is improved the specimens are returned to their cases, their interest for the future is purely historical—they are deposited among the archives of the arts. The influence of this improvement in public taste alone is not to be rejected.

It is obvious, then, that there are reasons why exhibitions should contribute to *aid* that which requires other causes to support. If they neither form the foundation of the building, nor yet its superstructure, they serve to determine its shape and the arrangement and distribution of its parts.

The influence of the medals and certificates awarded at these exhibitions is much undervalued by many, who, looking merely at their intrinsic value, consider them as so much silver or paper, They would value in the same way expressions of esteem as so much breath. The great dramatist has sufficiently held such persons up to ridicule by putting their argument touching honor in the mouth of that impersonation of all that is ludicrously contemptible —Falstaff. These testimonials have, however, a value in dollars and cents, which, though *I* cannot precisely estimate it, others may. Those who know enough to be aware of their own ignorance, look to others who have knowledge to guide their opinions. Thus the opinions of the judges, expressed at the exhibitions, become the guides of many and many purchasers, who seek or reject, not according to their own judgments, but according to the decisions of the Institute. Rely upon it, these exhibitions and the premiums awarded at them, have a powerful action upon the consumer, the vender, and the manufacturer, and through them upon the arts.

These periodical exhibitions are times of high excitement in the Franklin Institute. The public is called in, and the members are their entertainers. The fly-wheel of the institution appears to have been thrown out of gear, and the motion is rapidly accelerated. It could not exist under a long continued action of this sort. Why should not provision be made in the ordinary and regular working of the Institution for a constant exhibition? Why should all these products once collected be dispersed, never again to be re-united? Like the Conservatory of Arts, of Paris, or the Trade Institute, of Berlin, we should find such a collection a chronicle of the history of each art in our country. As in the Polytechnic Institute of Vienna, we should find by the side of models and machinery, the raw materials and products of our manufacturers and arts, from the date of their introduction, or use, to the day of exhibition. Were our *Sovereign* prepared to erect the piles of the Conservatory or of the Polytechnic school, we should easily find articles to fill their ample halls,—and is it impossible that this should ever be? Look at the structures raised by the public for education. Who would have believed forty years ago, that such would now exist by the means which have raised them? Voluntary association may do much, but not everything. The desire to accomplish this, among

other purposes, led to the attempt to extend the accommodations of the Institute in 1835. Perhaps under other circumstances we might have succeeded. Had the tide continued to rise, instead of beginning to fall, we might have passed the shoal, and found ourselves in smooth water on the inner side. We may now be satisfied that having ventured much for a great good, we are still safe. This branch of our Institute must bide its time. Meanwhile, the exertions of the Professors and members are forming the nucleus of cabinets of models and products of the arts, which promise to become of value; and the steps taken by the Managers to obtain from depositors specimens of those articles which take premiums or certificates, where the nature of them admits of it, will, if met in the spirit of liberality by the contributors, soon secure a useful and large collection. How interesting a view would have been presented of the progress of American arts, had such specimens been collected at all our Exhibitions! And while on this theme, does not memory call before us one dear to the Institute, as among its earliest friends, its founders, its first Professor of Chemistry, who made the earliest beginning of our cabinet of arts and manufactures, whose zeal and judgment connected him with our best and most useful efforts—though removed from us by death, he lives in our affections, and his name will be perpetuated in the history of our Institution. We already begin to have a history. Already the obelisk is raised, upon the base of which the names of the useful, zealous, and able, among the members of the Franklin Institute are to be inscribed at death—that tablet bears even now the names of Keating and of Ronaldson.

The awarding of premiums for inventions, though distinctly different in part of its operation from similar awards for the best specimen of any art, owes its efficacy to the same principles. It is not the value of the prize, but the value of the opinion, which causes the inventor to submit his designs for examination. This consideration of inventions forms part of the every day business of the Institute. Formerly it was done by the Committee on Inventions, and now by the Committee on Science and the Arts, formed by the voluntary association of the members of the Institute. The time and capital which have been saved to projectors, and to those who furnish them with means, through this Committee, are not the least important of its results. Men who were flattered at home with the idea of being Fultons and Watts, have found that, after all, Fultonism is not so easy of attainment, and those who were prepared to embark their means in schemes, have been saved both money and chagrin. Our countrymen are yet favored, occasionally, with the *novel and astounding* sight of vessels torn to pieces by the destructive agency of gunpowder, fired by the also *novel* method of a wire, heated by means of a distant galvanic battery—and all at the expense of the United States. With the explosion of unexplodable boilers, or of some old fashioned way of preventing this catastrophe. These things merely indicate, perhaps, a plethora in the National Treasury, or, perhaps, that all knowledge is not

given instanter, upon being elected even to high political stations. But, seriously, the award of the Scott's legacy medal and premiums, which our City Councils have delegated to the Franklin Institute, is the source of much usefulness, and, coupled with the opinions given by the practical and scientific men who are united in the Committee of Science and the Arts, has worked good to the arts, their cultivators, and their patrons.

In nearly all the institutions abroad to which I have referred, the publication of a journal in which to record inventions and improvements in the arts, and discoveries in the sciences which bear upon them, is regarded as of high importance. It is obvious, indeed, that this is the only effectual mode of diffusing a knowledge of improvement over a wide space. In days gone by, the mechanic of Continental Europe passed part of his appreticeship in wandering from place to place, to practice his art, as a means of support, and gathering the improvements which might have been made in it, to turn to account on his return home. Now the Journal brings to his door the improvements of the most distant places, with all the rapidity which steam navigation and railroad transit can give. There can be no doubt that of all the means of usefulness of the Franklin Institute, the publication of its monthly Journal is most widely operative. Its readers find a chronicle of the ingenuity of our country in the patents recorded in its pages, while they find the wheat separated to their hand from the chaff, winnowed by the labors of one who brings knowledge unsurpassed in this department to the execution of his work. Copious extracts from foreign journals convey the improvements of Europe to our mechanics and manufacturers, while original articles from our own mechanics, engineers, and men of science, contribute their full quota to the interest and usefulness of the work. It was early determined by the Institute that such a journal must be maintained, and the present periodical, originally commenced by the Professor of Mechanics, was adopted. The expensive nature of the work, its low price and the limited support which it was likely for many years to receive, forbade the idea that it would be a money-making undertaking; and the Institute has been satisfied to support it, as a means of usefulness, at a small annual loss in money. But, for a feature characteristic of the enterprizes of the Franklin Institute, there can be no doubt that this undertaking would have been onerous. Whenever a line of labor likely to benefit the public has been pointed out, and a scheme for rendering it available has been well matured, members have been always found willing to devote their time to its successful execution. It is thus that men engaged in laborious occupations, in which their time and talents are money, have devoted themselves, day after day, to labors enjoyed by the Institution, without looking for any other reward than that of being useful. It is thus that the pages of our Jornal are supplied with materials, original and selected, (some requiring the labor of translation from foreign languages,) by the generous labors of collaborators, whose zeal is tried by the monthly repetition of its exercise.

With all these resources at command, the Institute is still obliged to look to the benefit of this work to the mechanic, as a motive to support its expense, and to wait, in this as in some other enterprises, the time when a greater intelligence in our country at large and increasing resources, will fully repay the pecuniary outlay annually made.

One branch of the labors of the members of the Franklin Institute has, I believe, no precedent in any similar institution—I mean that of original investigation and research. The Institution thus aids to advance as well as to diffuse knowledge. Of the experiments of the Committee on Water Power, one of the highest living authorities (Mr. Rennie) has spoken in terms of the highest praise. The results of the experiments on the explosion of steam boilers have contributed strongly to turn attention away from imaginary sources of danger, and to fix them upon real ones. The conclusions from some of the more refined and difficult experiments, are quoted in quarters which cannot be suspected of either local or national partiality. These various researches, together with those on the strength of materials, must ever remain a monument of the industry and zeal of the early members of the Franklin Institute. They furnish a claim to public favor and support that no similar institution can justly put forth.

From these extended schemes, in which the members of the Franklin Institute are only incidentally partakers with the public in the common good effected by their instrumentality, let us turn our attention to the special means of promoting the mechanic arts, through the intellectual cultivation of those who pursue them. In the infancy of science, every experiment led to a discovery, and the art offered a scarcely less fertile field than science to their cultivators. Now discoveries in science and improvement in art, are the result of well directed trains of observation, experiment and thought. To direct these, the arts call in the aid of theoretical science. Besides the general cultivation of mind to be derived from pursuing any branch of knowledge, in the sciences of mechanics and chemistry are to be found those principles which alone are safe guides to improvement. It will, perhaps, hardly be believed, but it is, nevertheless, true, that not ten years since there lived in our city an ingenious man, who wasted his time and substance, and the resources of his family, in a pursuit after the perpetual motion. How many such disastrous results are prevented from year to year, by the application of principles taught in the lecture room, may be inferred from the number which require the additional nipping action of the Committee on Science and the Arts. Besides, the lectures upon mechanics and chemistry, which constitute the frame-work of our system, the filling up of architecture, mineralogy and mining, has been supplied by the voluntary contributions of members distinguished for their knowledge, and for their powers of communicating it; and even kindred branches of natural history have been, from time to time, furnished from similar sources.

It has always been the liberal policy of the Franklin Institute,

while retaining the control of the institution where, from its nature, the control should be retained—in the hands of mechanics—to call in the talents of other professions to their aid. While by the constitution, two-thirds of the Board of Managers must be manufacturers or mechanics, every citizen is free to become a member. No co-operation is spurned; and in return, knowledge, time, and talent, of various kinds, are at the disposal of the foster mother. This same liberal principle of action shows itself in the very moderate requital expected for all the privileges bestowed, by which membership in the Franklin Institute is placed within the means furnished by the deposit of one cent for each of the working days of the year. Exclusiveness is absent from each and every department of the Institute, and to a degree which, to those who believe such establishments are raised and must be used for the benefit of certain cliques, and the propagation of certain individual influences is almost startling. What would be thought of raising a voluntary committee of the members of an institution, the annual contribution to which of three dollars makes a member, to consider important inventions and improvements in the arts. Such a thing, the advocates of cliques would say, must lead to confusion. A voluntary committee is wholly uncontrolable—and so it should be. Just such a committee—just so uncontrolable—has existed and flourished in the Franklin Institute for several years, every member being at liberty to join it who is willing to perform the labor required of him. I do not think I overrate the importance of this association of members, when I place it next to the lectures. The library and reading room are no doubt more extensively useful to the members; but the knowledge acquired from books and experience, which is called into action in such various ways, and on so many occasions, in the Committee on Science, and the opportunities for intellectual culture afforded by calm investigation, by cool, but earnest, discussion, and by the appeal to experiment, are so practically improving as to rank above all passive means of cultivation.

Besides the Lectures, the Library, and the Committee on Science the Monthly Conversation Meetings serve as rallying points—as opportunities of giving instruction or of being instructed in the scientific or mechanical novelties of the day. In a large metropolis like London, it is always possible, during at least a part of the year, to obtain materials for even weekly meetings of this sort. At the Royal Institution of London, there is an informal lecture at least once a week, corresponding somewhat to our Conversation Meeting. If we could concentrate here the novelties which in our country find vent through various channels, we should be able to carry on these meetings with more spirit than is now done. In the meantime, they are often both agreeable and useful, and, doubtless, will be kept up with occasional intervals.

While thus providing for the improvement of its members, the Franklin Institute has not forgotten their families, their wives and daughters, as well as their sons, wards, and apprentices. When the lectures of the Franklin Institute first commenced, ladies were not

in the habit of attending lectures—in other words, custom most ungallantly excluded them from opportunities of intellectual amusement and advantage. The Institute has turned custom out of the doors, and taken the ladies within them.

A series of schools for youth at one time entered into the plan of the institution. Of these, the drawing school alone is still kept up with an efficiency and advantage which command patronage. I have very little doubt that had not public education taken the new position it now occupies in our city, these designs of the Institute would have been extended. The sovereign has now awaked to the advantages of supporting public schools by public means, although not yet fully prepared to push the principles upon which they are based to their utmost limit.

Among all these means of usefulness, there is no School of Commerce and the Arts like the Polytechnic Institution of Vienna, no School of Arts and Trades like the Berlin Institute, no School of Arts and Manufactures like the Paris Institution. The establishment of a School of Arts has been a favorite project with the Franklin Institute, but thus far has scarcely passed beyond a project; at one time on the point of receiving aid from the Commonwealth, at another almost put in operation by individual enterprize. This object requires means, and these we have not at our disposal. Will public opinion ever so far ripen as to furnish these means? This is an interesting inquiry. I have heard it remarked by more than one person conversant with the minutiæ of the institutions of Philadelphia, that all the enterprizes for the diffusion of knowledge are supported by a small portion of our population; and yet they are intended for the ultimate good of *all*, and should be supported by the *whole community*. There was no doubt a time when the idea of paying for the support of a fire department would have seemed preposterous, and now we quietly pay for insuring our houses, and then in addition, a portion of our taxes goes to furnish the means and appliances for extinguishing fires. What would we think now of supporting a fire department entirely by voluntary contributions? So public opinion oscillates from one side to another. What is at one time impossible, at another is firmly established as the general usage. Where shall we draw the line between that which is to be supported by general assessment, and that by particular contribution? *Shall the principle be that, what is for the good of the whole, shall be supported by the whole?*

It has been long established that the poor must be instructed at the public expense. It is found *cheaper* to educate the masses than to pay for the fruits of ignorance. Besides which, christian charity cares for the souls as well as the bodies of men. But the scheme of public education, free to all, is, even now, and in our own country, very imperfectly understood. Indeed it may be doubted if the public are yet prepared fully to follow it to its consequences. We began, in this country, after the example of the old world, to endow institutions for higher education, universities and colleges. Then we found that this was beginning to build the house at the top. We

turned and established schools, common schools, and occasionally a high school. And now the foundation and superstructure have no connexion. Is not this all wrong?

If we want precedent for a different state of things from the old world, we can find it, and so be borne out by experience, as far as institutions trammelled by feudalism can be guides to us. The so-called University of France includes all public institution within its organization; the highest and lowest are free; why not the middle? why not all?

But it may be said we agree that that which shall benefit all shall be supported by all. We agree that education shall be put upon a *truly republican* basis, that all the schools, from the lowest to the highest, shall be supported from the public purse, that a wider range shall be taken than now in education, and yet the whole shall be supported by the public. But you go further, you ask that institutions for the benefit of certain classes, by name merchants, manufacturers and mechanics, shall be supported or subsidized from the public purse. These classes certainly, in my view, make up no small or unimportant portion of our community. They are surely not so few in numbers, nor so insignificant in influence, that their interests may be overlooked.

But I would go beyond this, and include in one wide system all the institutions of every name for the promotion of knowledge. It is not necessary to weigh their relative usefulness. It would be easy to bring up an array which would include all classes of our community. The Mercantile Library has its objects, the Apprentices' Library others; the Philadelphia Library, the Athenæum, the Philosophical Society, the Academy of Natural Sciences, the Philadelphia Museum, the Athenian Institute, and many similar associations each and all have their spheres of usefulness. Take them together do not their objects include in their range the interests of every citizen of Philadelphia? Are they not intended for the benefit of classes which include all? Would not good done to all of them be done to the whole community? If not, let others occupy the vacant ground. Nor would the difficulty of adjusting claims be an insuperable one. For such it never has been in any country where such a plan has been in fact executed, and executed it has been in many, though not perhaps systematised. What, for example, is the support of the Polytechnic School of Vienna, and of its Conservatory, from the public purse, but part of such a scheme? and just such a part as the subsidizing of the Franklin Institute, under its present organization and management, would be. What the establishment of a Museum of Natural History and of Coins and Antiquities, but the support of the Academy of Natural Sciences and the Museum? What the support of a Royal Library but that of the Philadelphia Library? All of these, or nearly all, every where are under different boards of administration. The scheme is not so Utopian as, at first sight, it might appear. Our schools, colleges, universities, insitutes, museums, academies, associations, under whatever name, for the diffusion and advancement of knowledge, constitute an as-

semblage of objects, embracing within its scope all classes and all interests. Let me commend to your thoughts the idea of forming *a system* from these various parts, not centralized, but like our own political union, each independent, while all are united, *a great system of public instruction, worthy the patronage and support of a free and enlightened people.*

If public opinion were once right in regard to it, the details of the plan would present no serious obstacles. I have just read that a munificent Englishman has left nearly half a million of dollars to two institutions connected with the University of Oxford. Perhaps liberal individuals among us may one day turn their attention to the beginning of some scheme of general secular instruction, required imperiously in aid of moral and religious culture, by the nature of our political institutions. Without intelligence, virtue is comparatively powerless; without virtue and intelligence, liberty degenerates into licentiousness, independence into brutality. Liberty and independence exist but in name. When virtue, liberty and independence fail, the commonwealth which has chosen them as her watchwords, and has emblazoned them with the emblems of agriculture, commerce and the arts upon her arms, will cease to have a being.

Notice of Experiments regarding the Visibility of Lights in Rapid Motion, made with a view to the Improvement of Lighthouses; and of some peculiarities in the impressions made by them on the Eye. By ALAN STEVENSON, *LL. B., F. R. S. E., Civil Engineer.*

In experimenting on this subject, I used the apparatus formerly employed by Captain Hall. It consisted of an octagonal frame, which carried eight of the disks that compose the central part of Fresnel's compound lens, and was susceptible of being revolved slowly or quickly, at pleasure, by means of a crank handle and some intermediate gearing. The experiments were nearly identical with those made by Captain Hall, who contrasted the effect of a single lens at rest, or moving very slowly, with that produced by the eight lenses, revolving with such velocity as to cause an apparently continuous impression on the eye. To this experiment I added that of comparing the beam thrown out by the central portion of a cylindric refractor, such as is used at the fixed light of the Isle of May, with the continuous impression obtained by the rapid revolution of the lenses. Captain Hall made all his comparisons at the short distance of one hundred yards, and in order to obtain some measure of the intensity, he viewed the lights through plates of colored glass until the luminous disks became invisible to the eye. I repeated these experiments at Gullan, under similar circumstances, but with very different results. I shall not, however, enter upon the discussion of these differences at present, although they are susceptible of explanation, and are corroborative of the conclusions at which I have arrived, by comparing the lights at a distance of

fourteen miles, but shall proceed to detail the more important results which were obtained by the distant view. Several members of the Royal Society witnessed the results of the experiments, which I shall briefly describe in the following order:

1. The flash of the lens revolving slowly was very much larger than that of the rapidly revolving series; and this decreasing of size in the luminous object presented to the eye, became more marked as the rate of revolution was accelerated, so that at the velocity of eight or ten flashes in a second, the naked eye could hardly detect it, and only a few of the observers saw it: while the steady light from the refractory was distinctly visible.

2. There was also a marked falling off in the brilliancy of the rapid flashes as compared with that of the slow ones; but this effect was by no means so striking as the decrease of volume.

3. Continuity of impression was not attained at the rate of five flashes in a second, but each flash appeared to be distinctly separated by an interval of darkness; and even when the nearest approach to continuity was made, by the recurrence of eight or ten flashes in a second, the light still presented a twinkling appearance, which was well contrasted with the steady and unchanging effect of the cylindric refractor.

4. The light of the cylindric refractor was, as already stated, steady and unchanging, and of much larger volume than the rapidly revolving flashes. It did not, however, appear so brilliant as the flashes of the quickly revolving lenses, more especially at the lower rate of five flashes in a second.

5. When viewed through a telescope, the difference of volume between the light of the cylindric refractor and that produced by the lenses at their greatest velocity, was very striking. The former presented a large diffuse object of inferior brilliancy, while the latter exhibited a sharp pin point of brilliant light.

Upon a careful consideration of these facts, it appears warrantable to draw the following general conclusion:

1. That our expectations as to the effects of light, when distributed according to the law of its natural horizontal divergence, are supported by observed facts as to the visibility of such lights, contrasted with those whose continuity of effect is produced by collecting the whole light into bright pencils, and causing them to revolve with great velocity.

2. It appears that this deficiency of visibility seems to be chiefly due to a want of volume in the luminous object, and also, although in a less degree, to a loss of intensity; both of which defects appear to increase in proportion as the motion of the luminous object is accelerated.

3. That this deficiency of volume is the most remarkable optical phenomenon connected with the rapid motion of luminous bodies, and that it appears to be directly proportional to the velocity of their passage over the eye.

4. That there is reason to suspect that the visibility of distant lights depends on the volume of the impression, in a greater degree than has, perhaps, been generally imagined.

5. That as the size and intensity of the radiants causing these various impressions to a distant observer, are the same, the volume of the light, and, consequently, *cæteris paribus*. its visibility is within certain limits, proportionate to the time during which the object is present to the eye.

Such appear to be the general conclusions which these experiments warrant us in drawing: and the practical result, in so far as lighthouses are concerned, seems sufficient to discourage us from attempting to improve the visibility of fixed lights in the manner proposed by Captain Hall, even supposing the practical difficulties connected with the great centrifugal force generated by the rapid revolution of the lenses, to be less than they really are.

I shall be excused, I hope, for saying a few words in conclusion regarding the decrease in the volume of the luminous object, caused by the rapid motion of the lights. This effect is interesting, from the apparent connexion with the curious phenomenon of irradiation. When luminous bodies, such as the lights of distant lamps, are seen by night. they appear much larger than they would do by day; and this effect is said to be produced by irradiation. M. Plateau, in his elaborate essay on this subject, after a careful examination of all the theories of irradiation, states it to be his opinion that the most probable mode of accounting for the various observed phenomena of irradiation, is to suppose that, in the case of a night view, the excitement caused by light is propagated over the retina beyond the limits of the day image of the object, owing to the increased stimulus produced by the contrast of light and darkness; and he also lays it down as a law, confirmed by numerous experiments, that irradiation increases with the duration of the observation. It appears, therefore, not unreasonable to conjecture, that the deficiency of volume observed during the rapid revolution of the lenses, may have been caused by the light being present to the eye so short a time the retina was not stimulated in a degree sufficient to produce the amount of irradiation required for causing a large visual object. When, indeed, the statement of M. Plateau, that irradiation is proportional to the duration of the observation, is taken, in connexion with the observed fact that the volume of the light decreased as the motion of the lenses was accelerated, it seems almost impossible to avoid connecting together the two phenomena, as cause and effect.—*Edinb. New Philos. Jour.*

Wire Rope.—Mr. A. Smith has read a paper before the Society of Arts, on the manufacture of wire rope for standing rigging etc. The results of experiments made by order of the admiralty, are that standing rigging of wire rope of equal strength with the hempen rope, one third of the size and half the weight, may be fitted at about two thirds the cost. Mr. Smith stated that "the standing rigging now fitted in her majesty's Navy presents a surface of upwards of 600,000 square feet, which is about equal to the surface of the sails of twenty four first class frigates," that "one fathom of hempen rope

about three inches in circumference will absorb half a pound of water and will contract one inch in length. The standing and running rigging of a first rate, measures about 30,000 fathoms and will consequently when wet, contract in length on an average about 833 yards, or nearly half a mile, and absorb about seven tons weight of water, which being principally carried aloft will materially effect her sailing."

Mr. Norris' Miniature Locomotive for the King of France.—Our readers have seen the notice of a beautiful working model of a locomotive made by Mr. Norris for the King of France. The following notice of its performance will prove interesting to the friends of American industry.

The *Journal des Chemins de Fer* gives the following interesting particulars of some experiments to which the model has been lately subjected:—"His Majesty ordered a small railway to be constructed in one of the galleries near the Marine Museum in the Louvre. This construction was about 90 metres long and 36 centimetres wide, presenting all the inequalities of surface that might be met with in a real railroad.. The curves were of the smallest radius possible to be used, and such as will never be met with in actual travelling. Repeated trials of the locomotive were made, under the direction of the maker, in presence of his Majesty, surrounded by his family, several ministers, and a number of officers belonging to his household. The little locomotive drew without difficulty a carriage, in which was seated ten persons of his Majesty's suite, amongst whom was General Gourgand, and this was repeated several times with the most perfect success. His Majesty was pleased to express to Mr. Norris the great satisfaction he felt at the success of these interesting experiments, proving as they did that railroads may now be constructed in every description of locality, no natural ground presenting such difficulties as were designedly brought together on this occasion.

Carpets.—The new mill which is in progress of building in this city by the Lowell corporation, is intended for the introduction of new carpet power looms, which is a new invention by a young gentleman of this city. Heretofore, the hand loom alone has been used. By this new invention, one female will be able to do the work of three men. A few of these looms have been in operation for several months, and their complete success placed beyond a doubt.—*Lowell Cour.*

Automaton.—A machinist of a little town in Bohemia, has constructed an automaton, which imitates perfectly the human voice; sings several difficult airs with the greatest accuracy and executes shakes, runs and the chromatic scales with surprising precision. It also pronounces several words in singing.

Professorship of Civil Engineering.—Trinity College Dublin has established a chair and Mr. John Macneill has been appointed.

Wire Bridge.—In our last we gave extracts from a paper read by Mr. A. Smith before the Society of Arts. The following notice refers to the several communications of Mr. S. before the society.

A wire bridge, of 33 feet span, was erected in the room, the construction of which Mr. Smith explained. The wire rope, forming its principal support, weighed 56 lbs.; the angle-irons, 112 lbs.; and the other parts, including the braces, 56 lbs.; and 112 lbs. for the platform or footpath composed of boards—thus making the whole weight only three cwt., and which might be completed by four men, in about three days, at a cost not exceeding 15*l.*, and could, at any time, be taken down or put up in half an hour. These descriptions of bridges were described as very useful for military purposes, and for throwing over deep cuttings in railways etc., Mr. Smith stated, that for general practical purposes the cost might be taken at 1*l.* per foot run, with a breadth of three feet. Two smaller models of bridges, on different principles of construction, were also shown.

Burning Lens worked by the Drummond or Oxy-Hydrogen Light.—A colossal burning lens, three feet in diameter, and weighing 5 cwt., has been erected in the Royal Adelaide Gallery, intended to be worked by the Drummond, or oxy-hydrogen light. Some private experiments of this power of the Drummond light have taken place, when it was found that the bulb of a differential thermometer introduced into the focus, at a distance of 16 ft., was sensibly affected, and a piece of phosphorus introduced in the same point was fused. It has long been asserted that the heat accompanying light obtained by artificial means does not produce heat capable of being transmitted and concentrated through lenses; these experiments fully prove the contrary.

The *tailors* are threatened with the loss of trade, and the thimble and goose to be superseded by the shuttle and loom. Messrs. G. Martin & Co. having introduced into Philadelphia the English invention for weaving coats and pantaloons, and one of the papers speaks of one of their articles as being as comfortable an article of the kind as one could desire for common wear. Drawers and shirts have been woven in that city for some months.

Type Setting Machine.—An instrument invented by M. Gaubert for the purpose of composing and distributing type, has been presented to the Paris Academy of Science, for examination. The Committee in their report give credit to the genius and labor, but carefully abstain from any observation upon its economical use.

The King of France has presented *William Norris, Esq.* our celebrated Locomotive engine manufacturer, a gold medal, and a gold box ornamented with diamonds, besides giving him an order for the construction of several locomotives.

Timber Tank.—A wrought iron cylinder, 51 feet long and 6 feet diameter, has been erected in Portsmouth Dock Yard, for the purpose of "Burnettizing" timber under pressure. It is composed of plates half an inch thick, and double riveted, and the ends are of cast iron, with doors 2 feet 6 inches square, for the admission of logs. It is fitted with two air pumps of 14 inches diameter, for extracting the air, and two force pumps for increasing the pressure when filled with the solution. On a trial lately made before the Admiralty engineer Mr. Kingston, the cylinder having been charged with 20 loads of timber, the air pumps which are arranged to be driven by Lord Dundonald's rotary engine, were set to work, and a vacuum of 26½ inches was obtained in 30 minutes. A cock in the connecting pipe was then opened, and the solution rushed into the vacuum from the cistern. When the cylinder was filled with solution, the force pumps were set to work, and the pressure was raised to 200 lb. on the square inch. Under this pressure there was not the slightest leakage from any part of the cylinder, nor from the doors. The timber was removed on the following day, and a log was cut up, when it was found that the solution had penetrated to the very centre, and completely saturated it. The pressure at which the apparatus is in future to be worked, is 100 lbs. on the square inch, as this is found to be sufficient for the due saturation of the timber within 24 hours, under the process of previous exhaustion of the air. The whole of the work was executed by Messrs. W. Fairbairn and Co., of London, and the cylinder riveted machine, to which its great tightness may be attributed.

Comparative cost of English and Foreign Railroads.—In Mr. Robert Stephenson's elaborate and important report, addressed to the directors of the South Eastern Railway, on the system of railways, as now projected by the French government, he gives an analysis of the cost of railways in England, selecting three lines—the Northern and Eastern, the York and North Midland, and the Birmingham and Derby—as cases similar in their results to those in France now under consideration; from this, and also an analysis of the cost both of the Belgian and French lines, it appears the average cost per mile of the English lines is 25,450*l.*, the French lines, 23,000*l.*, and the Belgian lines, 16,206*l.*; thus showing a difference in the cost in favor of the Belgian lines over the English of no less a sum than 9,244*l.* per mile, and over the French of 6,794*l.*

Barker's Mill applied to Steam Navigation.—Mr. Less delivered a lecture on steam navigation, with a particular reference to the exposition of a principle proposed to be applied by Mr. Ruthven of this city, and for which he has taken out a patent. The lecturer gave a succinct statement of the history and progress of steam navigation, and remarked that the great obstacle to its extension was the imperfect nature of the paddle wheels. It was to obviate this imperfection that Mr. Ruthven had turned his attention, and his plan was sufficiently simple. It was to apply to the propulsion of

the vessel the principle which was known as that adopted in "Barker's Mill." It consists of a tube, horizontal or upright, into the extremity of which another tube, crossing it at right angles, was fitted, and open at both ends. When water was introduced into the first tube, it naturally made its escape at the two ends of the angular tube, but in its escape it caused this tube to revolve; the water, as it escaped, sending the tube forward in an opposite direction to that by which it escaped, and this with a force proportioned to the pressure of the water. The principle, in fact, is precisely the same as that which causes the recoil in a gun when it is discharged. It had been attempted to be applied to steam navigation before, but had always failed, because, in the lecturer's estimation, the water was always discharged below the surface, which impeded its power of action. He illustrated this by experiments, which certainly showed that the discharge of the water. below the surface of other water was not nearly so efficient as when it was discharged into the air. The mode of its application to the propulsion of vessels, was as we understood, by making apertures in the bows of the ship, through which the sea water would flow into pipes, and thus would be conducted to the place where the steam-engine was situated. There the water would escape by a large pipe running across the vessel and open at both ends, but with the apertures directed towards the stern, which upon the principle referred to, would have the effect of sending the vessel forward. If it was wished to back the vessel the aparatus could be turned in the contrary direction; and if to stop her, they had only to be turned directly down towards the bottom, while the engine never ceased working. In this case, we understand, the use of the engine would be to discharge the water out at the two apertures with a high degree of pressure as the speed of the vessel would be in proportion to the rush of the water. A small model was exhibited without a steam-engine, which showed the soundness of the principle. by the small skiff sailing, backing, and even turning, in water. The lecturer considered that vessels propelled in this way would have more velocity than those propelled by the paddle, besides the great advantage of dispensing with that imperfect implement.—*Edinburgh Courant.*

The Numeral Figures.—The types from which numerals are printed were, from the invention of printing till about 1785, formed so as to give heads, and tails to the figures, in the manner which is always used in handwriting. At the period just named, Dr. Hutton introduced in his logarithmic tables what was then a new form, in which the figures were all of one size, having no parts above or below the others. This system of Dr. Hutton's gradually became universal, much to the regret of all who had to consult mathematical tables, who were glad to use French tables, in preference to English, on account of the superiority of heads and tails. In the mean time, it was found that with figures all of a size, a larger type was necessary, to secure sufficient legibility, and this type gave facilities to that formation of thick and thin lines which distinguishes

the larger numerals of the existing English press from those of all other ages and countries:

1234567890

It was generally admitted that both circumstances,—the sameness of size, and the swelling of the lines which compose the figures, were unfavorable to legibility; but no steps were taken to restore the old type until lately, when some works were published in what was called the *French brevier*, being a type in which the heads and tails exist, and in which the thickness is as nearly as possible the same throughout. The Council of the Royal Astronomical Society and the superintendent of the Nautical Almanac, have recently come to the determination to restore the old form of the numerals in their respective publications, an example which is pretty sure to be followed in mathematical publications, and perhaps in others.

Deleterious Gas Detector.—An invention is described in the French papers which will, it is said, give such timely notice of the presence of deleterious gas in mines, or other places, as will enable persons to take the necessary precautions to guard against explosions. An explosion from the admixture of carburetted hydrogen with atmospheric air can only take place when the former exists in a certain and know proportion. When the quantity has reached or exceeded this point, the contact of a light instantly causes an explosion. The instrument recently invented has a sort of tell-tale to show the existence of danger, is simple, ingenious, and effectual. Connected with a chemical solution is a kind of float, nicely graduated, and attached to a counterpoise. The solution is of such a nature that it undergoes a change when acted upon by the admixture of carburetted hydrogen, and when saturated to a certain point the float changes its position, and acting in its turn upon the counterpoise, a spring is let loose, and strikes upon a bell or drum, giving out a loud sound, and thus indicating the presence of danger. This ingenious test is not liable to derangement, and the whole apparatus is comprised with a small compass, and of little cost. The solution can be varied so as to be adapted to every kind of deleterious gas.

Architectural Remains in Asia.—The *Commerce* states, that "most favorable news had been received from M. Tessier, appointed to direct the expedition sent to Magnesia, in Asia Minor, in order to raise the remains of the temple of Diana Leucophica. It appears that many more objects had been discovered than was originally expected, amongst others several columns in complete preservation, with their capitals sculptured with extreme delicacy, besides 12 bas-reliefs admirably executed, and a number of statues. The most friendly aid had been afforded by the French authorities in the Levant, and it is expected that a brilliant harvest is being reaped for the Academy des Beaux Arts at Paris."

Erratum.—On page 34, 16 lines from the top for "exchange" read "*enhanced.*"

AMERICAN

RAILROAD JOURNAL,

AND

MECHANICS' MAGAZINE.

No. 3, Vol. I. Third Series. | MARCH, 1843. | Whole No. 423. Vol. XVI.

☞ This number contains some articles which may appear out of place—bearing date subsequent to the date of the number. This arises from the circumstance that, when the undersigned took charge of the publication of the Journal, late in April, he found it behind time—and being aware of the effort necessary to overhaul a locomotive under way, he deemed it the better plan to run a "train" in both directions until the work should be "up to time" and a little in advance.

To be able to keep it always in advance, he relies much, very much, upon those whose interests are so closely identified with the improvement, and extension of the railroad system in the United States. We ask from every Engineer the result of his experience; and from every friend of railroads, his co-operation in giving circulation to the Journal. To the present subscribers who have, through good report and through evil report, stood by the work, and sustained it as well by their contributions to its pages as by the prompt payment of their annual subscription, he tenders his hearty thanks. And to those who have, like himself, and the railroad cause, for a few years past, been "off the track," he would say, be of good cheer—our turn is coming next. Let us lift together—sustain the Journal and it shall labor to sustain the cause. To the press, for its kindness, he is truly grateful for the past, and trusts that the Railroad Journal will continue to merit and receive its favorable notice.

D. K. MINOR.

IMPORTANCE OF RAILROADS, ESPECIALLY IN THE UNITED STATES.

We find in the New York American the following article from the Cincinnati Daily Chronicle, in relation to the present condition and future prospects of the United States. Assuming the past as a criterion for the future, we may look forward to a condition of things in this country truly sublime to contemplate. *One hundred* years ago and what were we? what are we now? and *what may not we be*, if we will, *one hundred years hence?* In **1743**, there was scarcely a *million* of inhabitants within the territory now claimed by the United States, estimated to contain **2,200,000** square miles. Now, in **1843**, there is about **18** millions, and it is safe to estimate that in **1943**, there will be over **300** millions, indeed Darby estimates the population of **1940**, at **386** millions; but say **300,000,000** of inhabitants within our present territory, reaching from the Atlantic to the Pacific, and from Canada to the Gulf of Mexico, embracing almost every variety of soil, and temperature of climate.

We may travel thousands of miles, in a direct line, without crossing our own boundaries; and over a more fertile soil than can be found elsewhere. We have rivers longer, and larger in the aggregate, and furnishing a better navigation than any other country on the globe. Our lakes would by others be called seas. We have a more intelligent, more enterprising and more prosperous population than can be found under any other government; of

course our *movement* is *onward*—our *progress rapid* and our *destiny* truly *sublime*—who can estimate it?

With such elements of prosperity, we must progress with a rapidity astonishing to calm observers under other influences; indeed astonishing to ourselves; and it becomes us as intelligent citizens to look well to the course which we mark out for ourselves. It is not yet 26 years since the first sod was upturned for the Erie canal. Only a *quarter* of a century, and still it is a great *great grandfather*, with a progeny "too numerous to mention," besides its *illegitimate* offspring, railroads, into whose hands the septre has fallen, and by which we are to progress hereafter at railroad speed, with locomotive power, on a level road, or gently ascending grade, until the different States of the Union are so intimately connected that *disolution* will be *impossible*. The past quarter of a century has been productive of important results. We have accomplished more in that period, in the way of improvement, and increase of facilities for the transaction of business, than was accomplished during a *century* previous. We are now somewhat in the condition of the student who has taken his degree at college—just prepared to begin to learn to *advantage*. We have studied some, practised more, and made some great mistakes, and are now in a better condition to *learn* than at any former period. Necessity requires us to proceed, the march is onward, and if we remain stationary, the *train*, *locomotive*, *tender*, *cars*, and all will pass over us. In other words, we shall fall behind the age. How important then that from this time we proceed on correct principles. Let us reason from the past and present to the future, and when we do resume our works of improvement in earnest, let us commence on the *main* lines and carry them forward gradually, but steadily towards the great points on the Mississippi at St. Louis, which is ultimately to become a large city; and north to the *Canadas* for defence, and the *latteral* roads, diverging to minor, but still important points, will follow as a matter of course.

The progress of population is so wonderful, and the causes of excitement and controversy are such that, with all the efforts of a wise conservative policy, we can hardly expect to maintain peace for a quarter of a century to come. There is a constant tendency among us to controversy. Uneasy spirits, with nothing but life, which is apparantly of little consequence in their own estimation, to loose, and everything to gain, a war with Great Britain is almost inevitable. And, therefore, it is of vast importance that we have main lines of permanent railroad, extending from the principal cities to the *interior*, to the *frontier*, to the *far west*, that troops, provisions, and munitions of war may be transported rapidly from place to place, and thus, by rapid movement, and unexpected blows, accomplish much in little time and with comparatively small means.

The economy in money alone, to say nothing of *health* and *life*, during even a short war like our last, would construct more than a *thousand* miles of railroad, of the first class, in this country, or a line from New York to St. Louis; and such a railroad would be equal, at least in the defence of our

9,500 miles of border line, to a regular army of 20,000 men, as, by it, troops could be collected from *eight* or *ten* States, at any point on its line, or at either extreme, in *three* to *five* days, thus *concentrating* or *distributing* a force wherever needed, which might bid defiance to any power on earth likely to attack us.

But the advantages of railroads, as a means of defence, great as they unquestionably are, are mere trifles in comparison with their benefits as a means of social intercourse and *union* among ourselves. Connect distant points by railroad, no matter how different the habits, manners and views of the people, they will soon become acquainted, and eventually assimulated and neighbors; thus dispelling prejudices and cementing friendships, calculated to perpetuate the institutions under which we have risen from a mere handful, and are *growing to be* the *mightiest* nation on earth. We are destined to become, if we remain *united*, and are *wisely* governed, the most powerful nation on earth, from the fact that we have the largest *fertile* territory in one body, with the greatest natural facilities for navigation in our numerous mighty rivers and lakes, and the most enterprising and intelligent people as a mass. Then how important that our improvements should progress under wise counsels, that we may keep pace with the spirit of the age, and find employment and sustenance for the coming millions predicted in the following article.

GROWTH AND POWER OF THE UNITED STATES.

Since the complete establishment of the American constitutional governments, the future growth and ultimate power of the United States has been a problem both with philosophers and political economists. There are two strongly exciting causes to this species of speculation. The first to discover the effect of the freest institutions mankind had ever adopted on the happiness and prosperity of the people under their influence; and the next to discover the natural growth of the only nation which, since the earliest ages of the world, has been left undisturbed in its natural progress. Half a century has not wholly determined these problems, beyond a contingency; but it has furnished us with some elements of the ultimate result. Those especially, which relate to physical growth and power, may be regarded as leading to certainties of result, beyond any disturbing causes, except that of Divine Providence. This future prospect is important, in considering our relations with other nations, and in determining our national policy. For this cause, we propose to take a birdseye view of the natural capabilities of the United States.

The surface of the United States comprehends a space of about two millions two hundred and fifty thousand square miles, and is about *one-twentieth part of the land surface of the earth.* More than one-half of this surface lies between the 35th and 45th degrees of latitude. It is, therefore, in the very heart of the temperate zone, where nature brings man and fruits to the highest measure of comparative excellence.

The circumference or border line of the United States is about *nine thousand five hundred miles in length.* It may be divided thus:

Boundary, in common with British N. America, about	3,700	miles,
Boundary, in common with Mexico,	2,300	"
Coast of the Pacific,	700	"
Coast of the Gulf of Mexico,	1,000	"
Coast of the Atlantic,	1,800	"
Total,	9,500	"

The territory thus enclosed includes also *nearly ten thousand miles of lake and river navigation*, of which two-thirds are in the valley of the Mississippi. The great lakes make a chain of about two thousand miles; the Mississippi two thousand more; the Missouri two thousand more; the Ohio nearly one thousand; and hundreds of minor streams from the St. Croix to the Sabine, make up thousands more.

It is important to observe, that this extensive country is admitted by geographers of former nations to have the most various soil, climate and productions of any country upon the globe. The inevitable consequence is, that its capabilities for population and wealth are correspondingly great. No country can surpass it in the capacity for production.

Of the whole two millions two hundred thousand square miles of surface, only about two hundred and fifty-five thousand lie in the Atlantic slope, and two-thirds of the whole lie in the valley of the Mississippi. To estimate rightly the population, which, under the natural and known laws of increase, will arise and be readily maintained on this surface, it is necessary, first, to consider for a moment the *arability and fertility* of the Mississippi basin.

The first fact we observe is, that the rivers of this basin are remarkably long. For example, the main stream of the Mississippi rises near latitude 48 degrees and joins the Gulf of Mexico about 29 degrees—thus running through about 20 degrees of latitude.

The Red river, of Louisiana, is estimated by Mr. Darby at one thousand miles in length. The Ohio, on the eastern side, is also one thousand, ascending to the heads of the Monongahela and Allegheny. The result of this is of vast importance. The rains and melted snows, which occasion the annual floods, fall on distant mountains, and raise those streams to great heights, pouring forth a vast volume of water. In proportion to the length of rivers, and their annual rise, must necessarily be the alluvial lands they feed. This is sufficiently illustrated by the river Nile, whose annual floods, coming from the distant mountains of Africa, occasion the fertility of Egypt.

In connection with this fact, we have nothing of equal consequence; that in this vast region there is very little space occupied by mountains, marshes, or lakes, incapable of production. Almost the whole surface is *arable*. These great facts, taken in connection with its locality in the midst of the temperate zone, determine the conclusion, that this great American basin is capable of producing more grain, and consequently, maintaining more people, than any other equal space on earth. So far as our cultivation has extended, the practical result corresponds with this theory, deduced from geographical facts.

The question of American population has become of great interest to speculators on the future progess and condition of the human family; for heretofore, the United States has populated with a rapidity beyond any conceptions which have been formed from the basis of European statistics. In the various estimates which have been made of the progress of American population, there are two, particularly worthy of notice. One by Darby, in a most excellent work, "View of the United States;" and the other by Professor Tucker, in Hunt's Merchants' Magazine.

Mr. Darby's estimate was made before the census of 1830, and is therefore subject to two tests:

	Estimate.	*Reality.*
1830	14,093,000	12,866,000
1840	10,335,000	17,063,000

But an important fact is to be noticed. The greatest error in Mr. Darby's

estimate was in the number of *slaves*, which according to his estimate would

have been in 1840,	4,114,000
But were in fact,	2,487,000

a difference of estimate equal to more than one-half the whole number of slaves. It is to be observed that this *over estimate* of the growth of the slave population has pervaded the calculations of all writers on the subject. They have never allowed enough for the two great *slave checks*, emancipation and bad condition. Mr. Darby proceeds to make an estimate for each year till 1940, one century from this time. The following are some of the results.

1860	35,167,000
1900	115,000,000
1940	386,000,000

Professor Tucker, in his calculations, published in Hunt's Merchants' Magazine, assumes that the ratio by which our population has increased will not long continue the same, but will gradually diminish as the number of persons increase to the square mile. This is mere matter of speculation; but when the people have become very dense, undoubtedly this is true; but as each new State is as fresh and fruitful as the oldest was, this check will not happen very soon. It is to be observed that the increase from 1830 to 1840 was 32½ per cent., which doubles in little more than twenty-four years. This ratio on the population extant one hundred years ago, will give the present actual result. So that this is the real natural increase of the American population. Professor Tucker's calculations give these results:

1900	80,000,000
1940	200,000,000

Comparing the estimates of Darby and Tucker, and taking the mean it may be considered certain that, without Divine interposition to the contrary, one century will increase the population of the United States to *three hundred millions*.

It may be interesting to know the ultimate *capabilities* of the American territory. Ireland contains eighteen thousand six hundred miles square of surface, and eight millions of persons. Notwithstanding this density of population, Ireland has yet a great deal of waste land. It is certain that the United States can contain as great a proportional population as Ireland. Take the same proportion, and it gives the United States an ultimate capacity of containing *eight hundred millions of people*—more than the entire population of the globe! In a historical point of view, the period may not be long before that prodigious result is reached; for in history, two or three centuries is not a very great portion of time. There is nothing in all this for the people of the United States to make a boast of; but there is much for gratitude, and much for contemplation.

The present generation will never see these astonishing results; but they are doing what will certainly influence widely these advancing millions. We do not believe that political society admits of much reformation in its old age, which was not attempted in its youth, any more than an old man is apt to change the habits of his life. The foundations we wish this vast political society to stand upon, we ought to have not only laid, but most firmly built up at this very time. In vain do we grow, if we grow not wisely. The power which the United States must have to maintain a happy liberty, is an intelligent moral power. They must do right and do right intelligently. The great levers of this power are the school, the press, and the church. The school needs to be more elevated, the press to be purer and better. Can we not attain a higher and a better standard?

AMERICAN RAILROAD IRON.

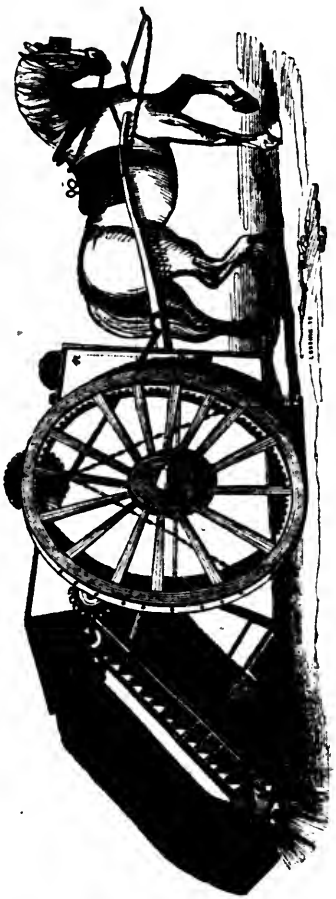
When on a visit to the *Albany iron and nail works*, under the management of John F. Winslow, Esq., near Troy, a few days since, we were gratified to observe that, notwithstanding the general depression of the business of the country, the proprietors of this establishment were enlarging their works preparatory to a more extensive business.

The manufacture of iron from the *pig* into nearly all its various forms, is carried on in this establishment, and then into *nails*, ship and boat *spikes*, and various other articles. We also discovered in our rambles—which were without a guide or any one to explain the half we saw, to advantage—through this extensive manufactory, that the manufacture of *steel* is carried on to a considerable extent, and we were shown, and now have in our office, a specimen of *files*, the manufacture of which has recently been commenced by Mr. Winslow.

But the information obtained which pleased us most was, that Mr. Winslow is ready to receive orders for the manufacture of *railroad iron*. The introduction of this branch of manufacture will be of immense advantage to this country. We have sent abroad within twelve years, more than thirty millions of dollars for railroad iron alone, which ought to have been paid to our own iron manufacturers. We have the materials of the very best quality, and we have also the *skill*, and the *enterprize*, and the *capital* to work them; but, unfortunately, there has not been given to it the attention necessary to perfect *machinery*, to enable us to compete with foreign cheap labor. It is idle to say we cannot do it. We *can* do it, and *shall* do it. Let those who have already done so much to elevate American character, in the improvement of American machinery, give their attention to the manufacture of railroad iron, as they have to other important subjects, and we shall ere long be able to supply the demand for railroad iron in this country from our own mines. If Mr. Winslow and his associates will give to the subject that attention which its importance demands, and overcome the *imaginary* as well as the real difficulties in the manufacture of railroad iron, they will be entitled to the thanks, the gratitude, and what is far more important, the *patronage* of their countrymen. And we shall be gratified if we can in any way promote their interest in this new effort to promote American manufactures. The *present* is perhaps the most fortunate period possible for them to undertake an enterprize so important. Capital in abundance, price of labor low, everything cheap, and the *energies* of the country rapidly assuming an elasticity which will surely give impetus to the railroad system, and carry out many an important enterprize projected and commenced years ago, but suspended by the *tornado* which swept over the land, and prostrated many a sturdy oak of rapid growth, whose branches had expanded more rapidly than its roots. The time is, however, at hand when many a tree, whose branches have for years been leafless, and whose roots have been upturned and withering under the scorching blasts of a baneful *sirocco*, will again take root and flourish and become, under a more careful culture, the pride of

the forest. We therefore say to the gentlemen of the "Albany iron and nail works," God speed you in your new enterprize. May you be successful, and derive a profit from the enterprize at least equal to the benefits which we hope may result to the country from the example.

WHITWORTH'S PATENT STREET SWEEPING MACHINE.



STREET SWEEPING MACHINE.

We gave, in the June number, a description, accompanied by a wood engraving, of Whitworth's street sweeping machine; which we found in the Civil Engineer and Architects' Journal for April. This machine has been introduced into use in Manchester, and after more than a year's experience in an extensive district, it has been found to answer well, and the commissioners of police recommend its use exclusively in the cleaning of streets in that city.

One of the machines has been sent to this city for trial, and has been used both in this city and Brooklyn, but not having the opportunity of seeing it in operation, we are unable to give an opinion as to its success, but of the entire practicability of the construction of a machine to clean our streets, *far more* thoroughly than it has ever been done, either under the old or the new system, we have not a doubt; and, if the testimonials accompanying the late report of the company using this machine in Manchester and its vicinity, extracts from which we give herewith, are to be relied on, as we doubt not they are, it is well worth the attention of our citizens, whose comfort, as well as interest will be greatly promoted by the use of machines with *wheels* instead of legs and *votes*. If a machine had *votes* in proportion to its superiority over the present mode of operation there would be no trouble in introducing it into use in every *city* and *village* in *this State;* and indeed it would not be singular if a few were sent out into the western wilds where some noble patriot has all the requisites, in his own estimation, except votes, to serve the dear people.

By the mode in use in this city during the past ten years, the loose dirt has been *stired* up, once or twice a week, in *dry* weather, but never disturbed when most troublesome, in *muddy* weather, thrown carelessly into carts, to be driven to the place of deposit, but owing to carelessness or design, no small portion of it is scattered to the four winds, as the carts pass through the streets, to the great annoyance of pedestrians, and housekeepers who are so thoughtless as to raise their windows for fresh air. By the new mode we understand that the work may be done quite as well in wet as in dry weather, and that it is much more thoroughly done than in the ordinary way, without dust in sweeping, and without scattering after it is deposited in the cart; and the expense of sweeping a given number of square yards is not half as much as in the ordinary way. We think the *health*, *convenience*, and *interest* of the citizens will be equally promoted by the introduction of *machine* sweeping in the streets of all our large cities. And, therefore, our efforts will be given to a better understanding of the subject. We give annexed, extracts from the company's last report, with other testimonials from witnesses competent to judge and speak of the merits of the machine.

EXTRACTS FROM THE REPORT OF THE ROAD AND STREET CLEANSING COMPANY.—MANCHESTER, FEBRUARY, 1843.

"The road and street cleansing company has been formed to carry into general operation throughout the united kingdom, the patent sweeping machine, invented by Mr. Joseph Whitworth, of Manchester. More than twelve months have elapsed since the machine was first set to work in that town, and during the greater part of that time it has been used throughout an extensive district, under the immediate direction of the company.

"In March, 1842, a part of the township of Manchester was assigned by the commissioners of police for trial of the machine, and a contract was entered into for working it therein during three months. The district included several principal thoroughfares, and contained upwards of 30,000 square yards of street surface. By the terms of the contract, the surface was to be cleaned three times oftener than under the old system, for three-fourths of the cost, or at one-fourth the former rate.

"The district in question soon presented a striking contrast with the other parts of the town, and before the contract expired, a memorial for its renewal and extension, signed by more than one hundred of the principal inhabitants, was presented to the commissioners. The contract was accordingly renewed for twelve months, and the district extended to include 90,000 square yards.

"The late commissioners, in their report for last year, recommend their successors to prepare for the exclusive employment of the machine, throughout the township, after the close of winter.

"It has recently been introduced into the adjoining township of Chorlton-upon-Medlock, the whole of which, containing 171,000 square yards, is now held by the company under contract.

"The working of the machine in these districts, has afforded ample opportunity of testing its capabilities, and furnishing satisfactory data for general calculation. The following are some of the actual results obtained in Manchester.

From the 25th of June, 1842, to the 9th of February, 1843—8,162,000 square yards were swept in the enlarged district, containing 83,000 yards of

paved streets, and 7,000 yards of Macadamized surface. The time occupied, taken on the average, for two machines, was 6½ hours per day for sweeping and loading, and 2½ hours for carting to the depot yards and unloading. This for 188 (the number of working) days, gives an average per machine, of 21,702 yards per day of nine hours. During a considerable portion of the time, only one horse was worked in each machine. Moreover, the period from June to February, includes nearly the whole of winter, when the work is heavier than at any other season. The average amount of work by one machine, with two horses, in the above district, may, therefore, be fairly stated at 24,000 yards per day, or 7,200,000 yards per year, of 300 working days. This quantity is equal to the performance of more than 20 men on the present system, in sweeping alone.

"The quantity of sweeping which each machine can do per day, must of course depend in a great measure, on the provision made for deposit. In the above calculation nearly one-third of the whole time is allowed for transport and unloading, being the average proportion of time so occupied in the company's district. But this is a much larger proportion than would be necessary under a permanent system, embracing an entire town. The depot yards might be so arranged as to prevent any loss of time in transport, and the cleansing power of the machine would be proportionally increased. Where provision cannot be conveniently made in large towns for deposit in yards at proper intervals, the patent machine may be constructed of two parts, viz: an upper, carrying the sweeping apparatus, and a lower, consisting of a loose box, suspended from the upper, and capable of easy detachment. Each machine having two or more of these boxes, may be kept constantly at work, depositing the full box in a suitable place, and taking up an empty box before provided—a skeleton cart being afterwards employed to convey the loaded boxes to the place of ultimate deposit.

"The average extent of surface swept by the patent machine for each load of street soil, has been about 4,000 yards. By the report of the police commissioners the average per load for the township of Manchester, in 1841, was 764 yards—a difference of more than 4 to 1, in the state of the same district, now, and at a former period.

"The result affords the most satisfactory and decisive evidence of the beneficial operation of the patent machine. It is also important, in reference to the required provision for deposit, showing that the depot yards may be placed more than two miles apart, while the time now occupied in transport, is saved to the machine.

"Sufficient opportunity has not yet been afforded to ascertain the amount of effect in promoting durability of street structure. But it is observed, that the streets swept by the machine, are dry after rain, long before those in the immediate neighborhood. The water rapidly finds its way to the channel, and has the effect of cleansing the surface of the pavement. The machine itself may be worked on pavement, during rain, with great advantage. The operation of cleansing is more effiiciently performed, and the water, which would lie in the hollows on the surface till evaporated, is at once removed. Provision is made for letting off the water collected in the cart, by means of a pipe, having its interior orifice some inches above the level of the mud after settlement. The cart when full is drawn to the side of the street, at some distance from a sewer grid, and the pipe-plug being withdrawn, the water flows into the channel.

"By a slight modification of the original form of the machine, it is enabled to sweep close up to the curb-stone, along the side of the street; and the hands before required to clean out the gutters, are dispensed with. The ac-

tion of the brooms is regulated with the greatest ease and nicety, according to the state of the weather, and the nature of the surface, by a series of weights, which counterbalance a certain portion of the weight of the sweeping apparatus, and relieve the pressure of the brooms on the ground. The brooms with the entire apparatus, may also be raised entirely from the ground, by means of a handle turned by the driver, whenever it is necessary to suspend the operation of sweeping, as, when the cart is full, or the surface obstructed The same handle will raise the sweeping apparatus into the horizontal position, when access is required to the hinder part of the cart, for the purpose of unloading.

"No difficulty has been found to arise in the management of the machine by ordinary drivers. It has been worked regularly on every kind of street surface, the round and square set stone, the Macadamized road, and the wood pavement, all of which are found in the districts before mentioned. Its peculiar advantage, as applied to wood pavement, in preventing the slippery state of the surface so much complained of, has attracted particular attention, and will, no doubt, tend to facilitate the general introduction of that useful invention.

"In Manchester, the average of the present rate varies from 3s. 6d. to 5s per 1,000 yards. By the aid of the patent machine, it will be generally reduced to about 1s. In most places, however, the greater part of the pecuniary saving will be absorbed in more frequent cleansing, while the advantages resulting to the public will chiefly consist in the improved state of the thoroughfares, and the consequently improved condition of the people.

The following extract from the fourteenth annual report of the lamp, scavenging, etc., committee, Manchester, 1842, shows conclusively that this mode of sweeping is altogether superior to the previous mode.

"In 1838, 13½ millions superficial square yards of streets were swept, from which were carted away 39,109 loads of sweepings; last year, 21½ millions superficial square yards were swept, but only 25,029 loads had to be removed, amply proving, that the system of scavenging in operation during the above period, has effected a highly beneficial change in the cleanliness of the town, tending, not only to the prevention of infectious disease, but to the effecting of a considerable saving in the wear and tear of the pavements. These advantages have been realised still more fully in the district assigned to the 'road and street cleansing company,' under the contract reported to the commissioners, in July last, and if their machine proves as efficient in the winter, as it has up to this time, the committee recommend their successors to purchase or hire a sufficient number for the town, and to work them under the exclusive direction of the commissioners."

"*Street Sweeping Machine.*—We understand that Whitworth's 'patent cleansing machine,' which has been in operation in Manchester for the last ten months, and has given universal satisfaction, is about to be introduced into the Metropolis. Manchester, instead of being the dirtiest, is now, we believe, the cleanest of our large towns. The introduction of the machine here, induced a smart competition betwen it and the old force of sweepers; and, although the latter are unable to maintain that degree of cleanliness in their districts, which is accomplished by the machine in the one allotted to it, the general improvement in the town, over former years, is very striking The difficulty of cleansing the crowded thoroughfares of London at this season of the year, by the old mode, appears almost insuperable; but we have no doubt, that the introduction of the machine there, will be attended with the same gratifying result we have witnessed here. The power of the machine is extraordinary, being equal to thirty men; and, in its operation,

the numerous annoyances which are inseparable from the old mode, are altogether avoided."

We could give numerous other extracts of a similar character, from foreign journals, but our object being merely to call attention to the subject, these will suffice—and with the following from the Tribune, and a cut representing the machine at work, we leave the subject for the present, with the remark, that if found in practice here, what it is represented to have been in Manchester, it will be put into use, even though the gentlemen of *Orange street*, may not altogether approve of it. We have *yet* to learn, that valuable improvements are to be discarded, or destroyed by a mob of those who have sought an asylnm among us from starvation and nakedness in their own country, simply because it may compel them to seek other employment.

The editor of the Tribune says, "An experiment was made yesterday in Chambers street, between Centre and Broadway, with the new 'street sweeping machine and self-loading cart,' which is of recent English invention, and has been hitherto entirely unknown in this country. The trial was made under the direction of C. J. Buchingham, Esq., the American agent of the patentee, and the machine used was one which he imported. Its operation was very successful, and fully illustrated the principle of the machine, which was all he intended to do, as those he proposes to build in this country will be improved in several essential particulars and be much lighter. A wide track was swept almost perfectly clean, the dirt being deposited in the cart and removed as the process of cleaning went on. No dust was raised, although the street was very dry; and the machine removes mud and stones with almost as much facility as ordinary dirt."

The London Architects' Journal for June says, that "The patent street cleansing machine of which we gave a detailed account in our April number has continued in daily operation in Regent street. All parties express themselves perfectly satisfied with its performance, and anxious to see it generally introduced. A public company is now forming for working the machine in the metropolis and its vicinity."

We shall be gratified to see this machine in successful operation, and to know that those interested are liberally compensated for their enterprize, but we give them warning that they may look out for competition if they are *thought* to be successful, as there is a great propensity in this country to out do other people, so great, indeed, that we not unfrequently out do ourselves.

The last report of Mr. Schlatter on the railroad from Harrisburg to Pittsburg having not yet received a notice in our Journal, we give in the present number several extracts from it. It would be impossible to follow out the details of the various routes without entering into local descriptions too minute and too extended to be of interest to the general reader.

A careful examination of this document has satisfied us of the immense amount of labor required to complete the thorough examination of the various routes. The result at which Mr. S. has arrived—a route remarkably direct between the termini, and at the same time presenting a more favorable grade than any other, when we consider the nature of the surface surveyed —may be esteemed one of the finest achievements of engineering science in our country.

We give the outline description of the preferred route with the cost of that line which adopts the most economical of the many sub routes given.

The report on the Chambersburg and Laughlinstown turnpike contains so much valuable information upon a neglected subject, that we have drawn largely from it.

There is also much that is useful in the principles laid down for the reduction of the routes to a level straight line, and this, together with the estimates of fuel etc., will be found highly interesting to engineers.

MIDDLE, OR PREFERRED ROUTE,

Which commences at the terminus of the Harrisburg and Lancaster railroad, at Harrisburg, and pursues the eastern shore of the Susquehanna river, to a point $4\frac{89}{100}$ miles, above Harrisburg, where it crosses the river, and follows the western bank to the mouth of the Juniata river. Thence, the line is traced along the southern shore of the Juniata to a point two and a half miles below Lewistown, where it crosses the river and canal, and follows the valley of the Kishacoquillas creek to a point five and a half miles above Lewistown, where the creek is crossed. Thence, the line runs in a north-westerly direction, until it strikes the Stone mountain, the slope of which it ascends gradually to a point favorable for piercing the mountain by a tunnel; thence, crossing the head waters of Stone creek, and the dividing ground between Stone and Shaver's creeks, the line descends the valley of Shaver's creek, and continues along the southern slope of Tussy's mountain, until a point on the Little Juniata, five miles above the Juniata division of the Pennsylvania canal at Petersburg, is attained. Thence, following the valley of the Little Juniata to Logan's Narrows, (where the ascent of the Allegheny mountain commences,) the line is traced on the side of the mountain, ascending with gradients varying from a level to forty-five feet per mile, until the summit of the mountain is attained at Sugar Run Gap. From this Gap, the line descends the western slope of the mountain to the Black Lick creek, (near Ebensburg) which it follows to its junction with the Conemaugh, below Blairsville. Crossing the Conemaugh, a very direct course is pursued towards Pittsburg, the line crossing the Loyalhanna about two and a half miles north of New Alexandria, passing near the towns of New Salem and Murrysville, following the Turtle creek to its junction with the Monongahela river, and by this river to Pittsburg. The total distance from Philadelphia to Pittsburg, by the route surveyed last year, and by the Columbia and Harrisburg and Lancaster railroads, was found to be three hundred and forty-eight miles. The surveys of this year have reduced this distance to less than three hundred and thirty-seven miles, making a saving of more than eleven miles, without, in any instance, exceeding the maximum grade of the Philadelphia and Columbia railroad, viz: forty-five feet per mile.

Graduation, masonry, and bridging on two hundred forty miles and thirty-six hundredths, for a *single* track,	$3,973,785
Two hundred forty miles and thirty-six hundredths of superstructure, at $10,000 per mile,	2,403,600
Turnouts and passing places,	72,000
Depot, buildings, water stations, etc.,	60,000
Engineering, superintendence, etc.,	100,000
Right of way and land damages, $500 per mile,	120,180
	$6,729,565
Add 5 per cent, for contingencies,	336,478
	$7,066,043

As the connection of the public works of New York with those of Pennsylvania, by means of the Williamsport and Elmira railroad, and the northern route of the Harrisburg and Pittsburg railroad, is looked upon as being of the greatest importance to the interests of the Commonwealth of Pennsylvania, as the means by which a great amount of trade and travel will eventually be passed through our State to the sea-board at Philadelphia, I have prepared, according to your direction, an estimate of the cost of constructing the connection between the Williamsport an Elmira, and the Harrisburg and Philadelphia railroad.

The distance from a point opposite Williamsport to the railroad at Harrisburg is ninety-one and a half miles.

The graduation, masonry, and bridging for a double track in this distance has been estimated at	$828,996
Single track of railway, ninety-one and a half miles, at $10,000 per mile,	915,000
Land damages, buildings, water stations, turnouts, and double track where necessary,	100,750
	$1,837,646
For engineering and contingencies add ten per cent.,	183,764
	$2,221,410
If the graduation is formed for the reception of a single track, the cost of the connection will be reduced to	$1,785,974
The estimate for completing the Williamsport and Elmira railroad, furnished me by the engineer of the road, is	740,000
Total sum required to connect the New York and Erie railroad, the Buffalo and Boston railroads, and the Erie canal with Philadelphia,	$2,525,974

As the distances between all the points from Dunkirk to New York, and to Philadelphia, have been now ascertained by means of railroad routes, either in operation, partially constructed, or surveyed, it may not be irrelevant here to exhibit the situation of each point of importance upon the routes leading respectively from Dunkirk, on lake Erie, to New York and Philadelphia.

FROM PHILADELPHIA TO DUNKIRK BY CONTINUOUS RAILROAD.

From Broad st., in Philadelphia, to State st., in Harrisburg,	106¾ miles.
From Harrisburg to Williamsport, by northern route of Harrisburg and Pittsburg railroad,	91½ "
From Williamsport to Elmira, by Williamsport and Elmira railroad.	74 "
From Elmira to Dunkirk, by the New York and Erie railroad,	194 "
Total,	466¼ "

FROM NEW YORK TO DUNKIRK.

From New York to Piermont, by the Hudson river,	22 miles.
From Piermont to Elmira, by the N. York and Erie railroad,	252 "
From Elmira to Dunkirk.	194 "
Total,	468 "

From the foregoing statement, it appears that the distance from Dunkirk to New York is one mile and three-quarters greater than from Dunkirk to Philadelphia. This statement is believed to be correct, as the distances from Dunkirk to Elmira, and from Elmira to Piermont, were taken from the second report of the directors of the New York and Erie railroad, dated February 1st, 1841, and are there stated to be predicated on the *shortest route*;

and the distance from Elmira to Philadelphia has been ascertained with great accuracy since the completion of the survey for the northern route of the Harrisburg and Pittsburg railroad.

I am not prepared, at this time, to enter into a comparison between these routes, as I am not in possession of sufficient information relative to the New York and Erie railroad, but it may be as well here to state, that, on the route from Elmira to New York, the gradients rise as high as sixty feet per mile, while on that between Elmira and Philadelphia, the maximum grade is confined to forty-five feet per mile.

The aggregate of ascents and descents on that portion of the New York and Erie railroad between Elmira and Piermont, on the Hudson river, (22 miles from New York,) is stated in the report before alluded to as being 3,820 feet.

The aggregate ascent and descent from Elmira to Philadelphia, via the Williamsport and Elmira railroad, the northern route of the Harrisburg and Pittsburg railroad from Williamsport, and the Harrisburg and Philadelphia railroads, has been ascertained to be feet.

SECOND REPORT ON THE SURVEY FOR A MACADAMIZED ROAD BETWEEN CHAMBERSBURG AND LAUGHLINSTOWN.

The plan of an artificial highway, or well constructed turnpike, with easy grades, extending through the broken and mountainous regions of the counties of Bedford and Somerset, for the purpose of connecting the Cumberland valley railroad with the contemplated railroad from Laughlinstown to Pittsburg, and thus forming a continuous communication from Philadelphia to Pittsburg, has been recommended for several years by those who advocate the interests of the southern tier of counties in Pennsylvania.

The combined nature of such a system of improvements, it has been alleged by its advocates, would allow of a very important saving of distance, if that part of the route which presents the greatest difficulties to the establishment of easy grades and direct courses, viz.: from Loudon to Laughlinstown, should be traversed by a turnpike.

As the employment of horse power on a turnpike for the transportation of goods may, under some circumstances, be found cheaper than the use of steam power, it was thought that the little expense with which goods could be transported over such a turnpike, added to the small tax which the cost and maintenance of such a road would impose upon the conveyance, would enable the improvement to compete successfully with rival lines. How far these views are correct, it is not for me here to decide; indeed it would appear premature to offer at this time a comparison between continuous lines of railroads which are now in course of construction, or in contemplation, and the improvement before us. It is true that the wagoning which is now carried on upon the southern turnpike, especially during the winter season, when the Pennsylvania canals are closed, will, as soon as the Baltimore and Ohio railroad is extended to Pittsburg, and a continuous communication by railroad established between Philadelphia and Pittsburg, entirely cease with respect to the transportation of goods from the Atlantic to the Ohio, and vice versa. But we should remember that the Cumberland valley railroad is in existance, and will be connected with the Baltimore and Ohio railroad—that this improvement extends through a very rich agricultural district; we should also consider that the growing population of the southern tier of counties will not only *require*, but be able in time to *support* a good turnpike themselves, and that the comparatively little cost of such an improvement will not require a very large business to sustain it, and we will come to the conclusion that this project should be treated differently from the manner in which rail-

roads generally are, and that, at least at present, it cannot be brought into a fair comparison with the other great thoroughfares from the east to the west.

The completion of the Baltimore and Ohio railroad is not very far distant, and the eventual formation of a continuous line of railway from Philadelphia to Pittsburg, by the shortest and best route, is equally certain. After these two lines have been in operation some time, and the Cumberland valley railroad has been extended to the Baltimore and Ohio railroad, we will be enabled to form a just estimate of the prospects of a combined improvement, which is to extend from Chambersburg to Pittsburg, nearly midway between the Baltimore and Ohio railroad on one side, and the Philadelphia and Pittsburg railroad on the other.

Actual surveys have rendered the idea of constructing a railroad through the counties of Bedford and Somerset, in the direction from the east to the west, to say the least, very problematical. The formation of the country appears to forbid such an attempt. The Laurel hill, Allegheny mountain, Ray's hill, Sideling hill, Scrub mountain, Scrub ridge and Cove mountain, form barriers, stretching parallel to each other directly across the course of the line, which appear effectually to prevent the attainment of short and straight distances, and the reduction of the gradients, upon which features the success of a railroad mainly depends. It was therefore but justice, while extensive surveys for a continuous railroad from Harrisburg to Pittsburg were being made, to authorize the survey for an improvement through the southern tier of counties which appeared to be best adapted to the character of that country, and would therefore promise a fair result. This survey has been made, and the distance from Laughlinstown to Loudon, by the line actually surveyed, was found to be ninety-nine miles, which may, by some alterations, and substituting the maximum grade in some places for a level grade, be reduced to ninety-eight miles. The distance by the present turnpike is eighty-seven miles, or eleven miles less. This may appear to some a great increase of distance, and there are many persons who entertain the opinion that a road, with no inclination greater than two and a half degrees, could be located with the same distance as the old turnpike. I am, however, convinced that the line established by the surveys of my principal assistant, Mr. Roebling, (with the exception of some minor alterations,) will be found, by future surveys, to be the best the nature of the ground will admit. Between the mountains we have invariably saved distance, but, in crossing them, we had of course to allow that distance which was necessary to overcome their elevations with grades not exceeding two and a half degrees. If a road should ever be made by the located line, its gentle gradients, (compared with the steep grades of the present turnpike,) would enable stage coaches to traverse the whole distance of Loudon to Laughlinstown, in thirteen hours, with less labor than it is now accomplished within the usual time of twenty-four hours. The greatest difference, however, would be experienced in the transportation of heavy goods. The best six horse teams are capable of hauling, on the present turnpike, when it is in good order, but from sixty to seventy-five cwt., the last being rather an extreme load. When the gradients are reduced to two and a half degrees, and the road kept always in a good state of repair, the same teams may then haul a load of six tons. One ton is the least allowance for one horse on well graded turnpikes in Europe, and the expense of hauling could not be cleared by taking less. It may be proper here to mention the charge of transportation on turnpikes. During the past season, many wagon loads of goods have actually been transported from Baltimore to Pittsburg for the trifling sum of from 75 cts., to $1 25 per cwt. The latter price is considered a fair compensation. One six

horse load was contracted for, to be taken from Baltimore to Zanesville, in Ohio, for $1 75 per cwt., and the wagoner appeared to be satisfied with his price.

No survey was made from Loudon to Chambersburg, as the site for a new and well located road would vary but little from the present turnpike.

Annexed to this report (54) will be found a table exhibiting the results of the estimates of cost for each mile of road, together with the average prices, amount of excavation, length of bridges, etc,

The dimensions of the road and the slopes of the banks, upon which the estimates have been based, vary with the nature of the ground. Where the ground is level, or not much sideling, the whole width of the road bed between the ditches is assumed at thirty-four feet—the side ditches on such locations to be six feet wide on top, and two feet deep. The metalling or stone-way, will be eighteen feet wide, leaving an earth or summer way of eight feet wide on each side, between the stone way and the ditches.

In deep cutting, the width of the road bed between the ditches is reduced to twenty-four feet, leaving a foot-path of three feet on each side of the stone way. The latter preserves its width of eighteen feet throughout. The ditches are in this case assumed as four feet wide on top.

High embankments occur but seldom, and will have a width of twenty-six feet on top, leaving a foot-path four feet wide on each side of the stone way. The slopes of the embankments to be one and a half feet to one in common earth, and one to one in harder material.

Where the sideling ground is steep, (as in the mountains,) the width of the road, including the ditch on the side hill, will be thirty feet. The stone way still continuing eighteen feet in width, and leaving a foot-path of five feet on the side of the valley, and one of three feet on the hill side, bordered by a ditch four feet wide. The slopes to vary from one and a half to one, to one to one.

The following plan for constructing the stone way, is that upon which the estimates have been made out.

A bed for the reception of the foundation is first excavated eighteen feet in width, by a curved pattern, so that the centre be six inches higher than the ends. Along the two sides of this bed small ditches are cut, from three to six inches wide, and from three to six inches deep. The material of the whole of this excavation is used to raise the summer ways on each side, so that they will slope off from the metalling to the ditches. The small ditches serve for the reception of two rows of curb stones, set upright, so that they project ten inches above the bed. Sound, flat stones are to be selected for this purpose. The curb stones form the sides of the foundation, and prevent it from spreading out; they are essential to the preservation of a good road.

The first layer of stones is regularly and closely packed, in the form of a pavement. The stones are always set upright, and when of a flat form they are set lengthwise across the road. At the same time the broadest end is used as the base, and the rougher and more pointed the tops of the stones are, the better, so that they may the better receive the next layer of broken stone. The thickness of this foundation is to be from five to six inches at the sides, and from six to seven inches in the middle. All kinds of hard stone, as limestone, freestone and graywacke, may be used for the packing.

The second course is to consist of a layer of broken stone, five inches deep at the sides and seven inches deep in the middle. The material may be of the same nature as the packing, but it must be broken so that each stone will pass through a four inch ring. The first portion of this course when spread

over the foundation, must be well rammed into the lower course, by which process the surface of the packing will become consolidated and even.

After the second course has been laid on, and rounded off by a pattern, the third and last course is to be put on, from four to five inches thick at the sides, and from five to six inches thick in the middle. This course will cover the curb stones, and be confined by the summer road or foot ways. The lower part of the top course may consist of broken stone which will pass through a two inch ring; the covering however should not contain stone larger than one and a half inches.

No other material to be used for the third course than limestone or kieselshieffer.* Wherever the latter material can be had within a distance of two miles, it should be prefered to limestone.

The surface of the stone way when finished, will form a curve of nine inches rise in the middle, and slope off on each side. These slopes are continued over the summer ways to the ditches. The whole thickness of the metalling by the above plan will be eighteen inches in the middle, and fifteen inches on the sides. The sectional area will be twenty-five square feet, therefore the cubic content is twenty-five cubic feet, or one perch per lineal foot, or five thousand two hundred and eighty perches per mile.

The cost of metalling and finishing the road as above described, is estimated at $5,800 per mile,† and by allowing this sum, a road may be obtained as good as any in existence, in this country or in Europe. Such a road will be capable of supporting the heaviest traffic, and by adopting a judicious system of constant repair can be kept in the best order at a very moderate yearly expenditure.

The plan for the formation of the stone way here proposed has been extensively used, and with the most perfect success, by the most distinguished European engineers. The main features are the same which were adopted by Messrs. Telford, M'Neill and Wingrove during their extensive practice, and recommended by Sir Henry Parnell, after an experience of twenty years as an active and efficient parliamentary commissioner of roads, in his excellent treatise on this subject, published in 1838. The French engineers have always favored this plan; and several thousands of miles of roads have been constructed upon this principle in Prussia, where its merits have been satisfactorily tested, and where road making is well understood.

It was only owing to the bold and imposing assertions and plausible arguments of Macadam, that the system called after his name, became, to a certain extent, popular, in spite of common sense, and partially superceded the plan established by experience and reason. Macadam's system has everything against it, and nothing to recommend it, and cannot be supported by an experienced and judicious engineer. The parliamentary investigations (pursued with so much patience and sagacity,) instituted for the purpose of

* This material was found by Mr. Roebling in the course of the survey, west of Tussey's mountain, in great abundance, lying in vertical veins embedded between limestone rock. It is a species of flint, and is considered as the very best material for the upper layer of a stone way. It is almost a pure silex, thefore not liable to produce dirt upon the road, and at the same time it is easily broken. When fractured, its particles, owing to the roughness of their edges, will not give way, but unite into a solid mass. The properties of this valuable material appear not to be understood by those who have the management of the present road; the coarsely broken limestone, is, under the present system of repairs, preferred, because a road which is never well attended to, and always full of ruts, is more easily and quickly repaired when once reduced to its worst state by throwing on masses of course material which will not yield to the action of the wheels. A road having the upper surface covered with kieselshieffer, requires a little attention constantly, but can with very little care be kept in a high state of preservation, and perfectly smooth at all times. The most valuable material next to kieselshieffer is limestone.

† "Although the expense of constructing a road on this plan may seem to be great, on an average of five years, the joint expense of constructing and repairing such a road will be less than that of constructing and repairing a road made by putting the surface materials on the natural soil, without a paved foundation; for, in point of fact, such a road has usually to be nearly new made every year for some years after it is first opened."—Sir Henry Parnell, on Roads.

ascertaining the most approved form of road making, have drawn from the most skilful and experienced engineers and road surveyors, their opinions relative to the plan pursued by Macadam, and that carried to such perfection by Telford.

After a careful perusal of these investigations, together with the valuable works which have been written upon this subject—and after an attentive observation of the effect of travel, time and wet weather, upon the Macadamized roads in this country—but one opinion can be formed of Macadamization and Telfordization; (the word is used by Dr. Lardner in the course of his examination before the committee of the House of Commons,) the preference must be given to the latter system of road making.

The total cost of grading and bridging from the terminus of the railroad line at the western end of Laughlinstown to Loudon, 99 $\frac{44}{100}$ miles, is $506,425 21

Add to this the cost of metalling on the plan proposed, at $5,800 per mile, 575,592 00

$1,082,017 21

Or $10,903 04 per mile.

If a depth of stone of twelve inches, (instead of eighteen inches,) should be determined upon, the cost would be reduced to $4,000 per mile, so that a road can be made between Chambersburg and Laughlinstown with a stone way far better adapted for rapid travel and heavy wagons than any we have in the State, for $803,385 52. Twelve inches of metalling is more than is usually placed upon turnpike roads, but is equal, when laid on by the plan I propose, to twenty inches placed on in the common way, from the great solidity which the road acquires from the strength of the foundation, and the method of its construction.

Appendix, exhibiting the principles upon which the comparisons between the different routes are predicated, together with the comparisons and their results:

1. REDUCTION OF GRADIENTS TO A LEVEL AND STRAIGHT LINE.

In order to be enabled to enter into the calculations required for ascertaining the cost of transportation and management of a railroad, it becomes first necessary to reduce the gradients and curvature to a level and straight line. The extent of a straight level thus allowed for the gradients and curvature, added to the actually measured distance, will give the *virtual* distance of the line.

The amount of steam power necessary to convey a load over a succession of ascents, is equivalent to the power required for lifting the same load through a perpendicular height equal to the aggregate ascents of the inclines, plus the power to be consumed for conveying the same load over a level distance of the same extent. Now, it is generally admitted that the amount of power which is necessary to raise a load through a perpendicular height of twenty-one feet, is equivalent to what is required for the conveyance of the same load over one mile of level and straight road in the same time. To reduce, therefore, the ascents to a level, we should divide the aggregate rise by twenty-one, and the quotient will express the number of miles to be added to the measured distance. But as the ascents differ in the two directions materially, we should perform the reduction both ways.

When a train descends a plane, the inclination of which is equal to the angle of repose, it is evident that no power from the engine will be required to propel the load; its own gravity will be sufficient to overcome the resistance arising from friction. Now as the engine in so descending exerts no power of traction, it is clear that the additional friction of the engine itself, which

on a level or on an ascent results from this traction, and which amounts to about one pound per ton of load, ceases to exist. We have only to consider the resistance due to the friction arising from the weight of the load, which is established at from eight to nine pounds per ton, and the resistance resulting from the motion of the engine itself, and which amounts to about one hundred and fifty pounds for an engine of ten tons weight.

By dividing 2240 by 9, we obtain $\frac{1}{249}$ one foot rise in a distance of two hundred and forty-nine feet, as the inclination corresponding to the angle of repose for the load, and which is equal to 21·20 feet per mile. The inclination of repose for an engine of ten tons weight, the friction of which amounts to one hundred and fifty pounds, is equal to $\frac{1}{2240}$ or $\frac{1}{149\frac{1}{3}}$, equal to 35·43 feet per mile, which is considerably more than the angle of repose for the load. From this it appears we cannot fix the angle of repose for a descending train, without determining the whole weight of the train.

Suppose the average gross weight of the train itself to be 250 tons, and that of the engine 10 tons. The resistance of the train due to friction is therefore 250×9= 2,250 lbs.

Add the resistance owing to the friction of the engine, 150 "

And we have a total resistance of the train, 2,400 lbs.

The aggregate weight of the train and engine in pounds is 206×2,240 =582,400 pounds. This divided by the total resistance, gives us 582,400 ÷2,400=$\frac{1}{242\frac{1}{6}}$ as the rate of inclination which corresponds to the angle of repose for the whole train, and dividing one mile 5,280 feet by 242·66, we obtain 21·76 as the descent per mile equivalent to the angle of repose.

In practice, however, a greater expenditure of steam power will take place, than is required by the above calculation. Where the grades are undulating, the steam power has to be kept up on descent in order to obtain a sufficient accumulation of power to overcome the following ascents. And on long descents, say of 45 feet per mile, safety requires a ready store of power to be applied for reversing the motion of the engine in case of accidents. Some loss of fuel will therefore be incurred from these causes.

No experiments have yet been made by which we can determine the precise amount of steam power required on descending planes, to overcome the resistance of friction and the atmosphere.

On inclinations of less than thirty feet per mile, and on short undulating gradients, from a level to forty-five feet per mile, we may assume the saving of power resulting from a descent of thirty-five feet, as equivalent to the power required on one mile of a straight level. No power will therefore be needed on a descent of 35 feet per mile, or planes exceeding this inclination, provided such descents are of no great extent, and are followed either by ascents, levels, or descents under thirty feet per mile. This principle, however, will not apply to long planes descending more than thirty-five feet per mile. On such descents an actual gain of power, resulting from accelerated velocity, would take place, according to the above supposition. But as it is dangerous to increase the speed beyond certain limits, or to make use of the accelerating force of gravity to its full extent on steep inclines, nothing will be gained from any excess of gravity, but what is wanted to overcome the friction of the train.

In such cases, as for instance on the eastern descent of the Allegheny mountain, from the west to the east, we should allow, say fifty feet of descent, as equivalent to one mile of level in point of expense of steam power. Or the amount of steam power required on one mile of road, descending forty-five feet, is equivalent to the power expended upon a straight and level road of $\frac{50}{5}\cdot\frac{45}{0}$ or $\frac{1}{10}$ of a mile in length.

2. REDUCTION OF CURVATURE.

To exhibit the effect which the curvature of the road will have upon the locomotive power, we will adopt, as a basis for our calculations, the result of experiments which were made for that purpose by the engineers of the Baltimore and Ohio railroad.

The resistance arising from a curvature equivalent to three hundred and sixty degrees of deflection, was found to be equal to the amount of resistance of a straight and level line of 0·238 miles. The mechanical resistance arising from the curvature of a line, will, therefore, be equivalent to the resistance of a level and straight line, the extent of which is obtained by dividing the aggregate sum of degrees of deflection by 360, and multiplying the quotient by 0·238.

FUEL.

The quantity and cost of fuel for transportation at different speeds has been ascertained and nearly reduced to a certain standard on different roads in this country and in England. From these facts, we have, with a due regard to circumstances, allowed one-fifth of a cent as the average cost of fuel for the conveyance of one ton gross weight of passenger trains, over one mile of level and straight road, at a velocity of twenty miles per hour; and one-tenth of a cent as cost of fuel for one ton of freight train, over one mile of level and straight road, at a velocity of ten miles per hour.

COST OF MACHINERY AND WEAR AND TEAR.

The wear and tear of the machinery will be nearly in proportion to the work performed. Now, as its capacity will be nearly regulated to the grades, the wear and tear may be estimated in proportion to the actual running distance, including the equation for the curvature of the road.

The annual expense of wear and tear, and depreciation of a locomotive engine and tender for passenger trains, will be assumed at $2,500
And the engine and tender for freight trains, at 2,000
Of a passenger car, including oil, 500
Freight, " " 145

REPAIRS AND SUPERVISION OF ROAD.

The annual repairs of the graduation, culverts, and double railway track, including the supervision of the road, is estimated at $800 per mile. The annual repair of the wood-work of viaducts is estimated at 4 per cent. on the first cost.

TO PHILADELPHIA.

No. 1.	Projected railroad from Cleveland to Pittsburg,	130·00	miles.
	Harrisburg and Pittsburg railroad, (middle route,)	229·57	"
	Harrisburg and Philadelphia railroads,	106·75	"
	Total distance from Cleveland to Philadelphia,	466·32	miles
	Maximum gradient, 45 feet per mile.		

TO BALTIMORE.

No. 2.	Projected railroad from Cleveland to Pittsburg,	130	miles.
	Baltimore and Ohio railroad,	337	"
	Total distance from Cleveland to Baltimore,	467	miles.
	Maximum gradients, 84 and 66 feet per mile.		

TO NEW YORK.

No. 3.	From Cleveland to Philadelphia as by route No. 1,	466·32	miles.
	From Philadelphia to New York by railroad,	85	"
	Total distance from Cleveland to New York,	551·32	miles.
	Maximum gradient, 45 feet per mile.		

TO PHILADELPHIA VIA ERIE.

No. 4.	By lake, from Cleveland to Erie,	120·00	miles.
	By Sunbury and Erie railroad,	286·56	"
	By Sunbury and Catawissa, Little Schuylkill and Susquehanna, Little Schuylkill and the Reading railroads,	148·44	"
	Total distance from Cleveland to Philadelphia, Maximum gradient, 66 feet per mile.	555·00	miles.

TO NEW YORK VIA DUNKIRK.

No 5	By lake from Cleveland to Dunkirk,	170	miles.
	By New York and Erie railroad,	448	"
	By Hudson river, from Piermont to New York,	22	"
	Total distance from Cleveland to New York, Maximum gradient, 60 feet per mile.	640	miles.

TO BOSTON VIA BUFFALO.

No. 6.	By lake from Cleveland to Buffalo,	210	miles.
	By Batavia and Buffalo railroad,	36	"
	By Rochester and Batavia "	33	"
	By Auburn an Rochester "	78	"
	By Syracuse and Auburn "	26	"
	By Utica and Syracuse "	53	"
	By Utica and Schenectady "	78	"
	By Mohawk and Hudson " (to Albany,)	16	"
	By Western "	157	"
	By Boston and Worcester "	44	"
	Total distance from Cleveland to Boston, Maximum gradient, 80 feet per mile.	731	miles.

TO NEW YORK VIA BUFFALO.

No. 7.	By lake to Buffalo,	210·00	miles.
	By railroads from Buffalo to Albany, as by route No. 6 and by the New York and Albany railroad,	467·71	"
	Total distance from Cleveland to New York, Maximum gradient, 60 feet per mile.	677·71	miles.

TO PHILADELPHIA.

No. 8.	Total distance by railroads as by route No. 4, Maximum gradient, 66 feet per mile.	435	miles.

TO PHILADELPHIA.

No. 9.	Projected railroad via Meadville, Allegheny river, Kiskiminetas and Conemaugh, to the middle route,	171·00	miles.
	Middle route, from the point of intersection, to Harrisburg,	187·25	"
	Harrisburg and Philadelphia railroads,	106·75	"
	Total distance from Erie to Philadelphia, Maximum gradient, $52\frac{80}{100}$ feet per mile.	465·00	miles.

TO NEW YORK VIA DUNKIRK.

No. 10.	By lake to Dunkirk,	50	miles.
	From Dunkirk by New York and Erie railroad, and by Hudson river, as by route No. 5,	470	"
	Total distance from Erie to New York, Maximum gradient, 60 feet per mile.	520	miles.

TO NEW YORK VIA BUFFALO.

No. 11.	By lake to Buffalo,	90·00	miles.
	Railroads as by route 7,	467·71	"
	Total distance from Erie to New York,	557·71	"
	Maximum gradient, 60 feet per mile.		

TO BOSTON VIA BUFFALO.

No. 12.	By lake to Buffalo,	90	miles.
	Railroads as by route 7,	521	"
	Total distance from Buffalo to Boston,	611	miles.
	Maximum gradient, 80 feet per mile.		

TO NEW YORK—BY RAILROAD AND RIVER.

No. 13.	New York and Erie railroad,	448	miles.
	Hudson river from Piermont to New York,	22	"
	Total distance from Dunkirk to New York,	470	miles.
	Max. gra. 60 ft. pr mile, from Elmira to N. York.		

TO PHILADELPHIA—BY RAILROAD.

No. 14.	New York and Erie railroad to Elmira,	194·00	miles.
	Williamsport and Elmira railroad,	74·00	"
	Northern route of the Harrisburg and Pittsburg railroad, as located from Williamsport to Harrisburg,	91·50	"
	Harrisburg and Philadelphia railroads,	106·75	"
	Total distance from Dunkirk to Philadelphia,	466·25	miles.
	Max. gra., 45 ft. pr mile, from Elmira to Phila.		
No. 15.	Total distance from Buffalo to New York by the railroads to Albany, as by route 7, and the New York and Albany railroad,	467·71	miles.
	Maximum gradient, 60 feet per mile.		
No. 16.	Total distance from Buffalo to Boston, as by railroads in route 6,	521	miles.

TO NEW YORK.

No. 17.	From Buffaly, by the grand Erie canal and the Hudson river,	508	miles.

TO PHILADELPHIA FROM ERIE.

No. 18.	Erie extension of the Pennsylvania canal,	104·50	miles.
	Beaver division, " " "	30·75	"
	Ohio river to Pittsburg,	26·00	"
	Western division of the Pennsylvania canal,	104·00	"
	Portage railroad, " " "	36·00	"
	Juniata division, " " "	127·50	"
	Eastern, " " "	44·50	"
	Philadelphia and Columbia railroad,	82·00	"
	Total distance from Erie to Philadelphia by State improvements,	556·25	miles.

TO PHILADELPHIA FROM CLEVELAND.

No. 19.	Ohio canal from Cleveland to Akron,	38	miles.
	Pennsylvania and Ohio canal to Beaver division,	84	"
	From point of junction of P. and O. canal, by Beaver division, to the town of Beaver on the Ohio river,	22	"
	Ohio river to Pittsburg,	26	"
	Western division, Portage railroad, Juniata division, Eeastern division and Columbia railroad,	394	"
	Total distance from Cleveland to Philadelphia,	564	miles.

RAILWAY TRAFFIC IN ENGLAND.

We give the annexed extract from the London Railway Magazine, of 29th April, to show the immense amount of travel in Great Britain, by railways. *Twenty millions* of passengers carried on railways, besides all other modes of conveyance, and at a cost of £4,000,000 a year. It will be hardly credited here—though probably within the truth.

"The following calculation of the last weekly returns of 44 railways, 1,560 miles in length, given in our present number, will, we believe, be of interest: number of passengers on 28 railways, 327,142, consequently the total for the week must be about 500,000. The receipts for passengers on 44 railways, £68,832 17s. 3d.; ditto for goods on 39 railways, £22,526 10s. 11d.; total. £91,359 8s. 2d. This is an average of £58½ per mile per week. The traffic, therefore, is certainly at the rate of about four millions and a half a year, and carrying twenty millions of passengers.

NAME.	Passengers per week.	Total receipts.	Total 1842.
Brimingham and Derby,		£1337	£1062
Birmingham and Gloucester,		1759	1508
Brandling Junction,	11,562	795	745
Chester and Birken,	3,839	495	455
Dublin and Kingstown,	32,178	764	874
Durham and Sunderland.	2,864	599	
Edinburgh and Glasgow,	10,039	2014	2072
Eastern Counties,	20,183	2304	891
Glasgow and Ayr,	15,107	1070	956
Glasgow and Greenock,	16,129	687	658
Grand Junction and Ch. and Cr.,		6956	8636
Great North of England,		1407	1304
Great Western,	33,625	13723	12951
Hull and Selby,	4,173	1,085	960
Liverpool and Manchester,		3795	3833
London and Birmingham,		15859	16313
London and Blackwall,	42,131	682	848
London and Brighton,	11,820	3435	2232
London and Croydon,	4,627	308	443
London and Greenwich,	24,610	773	830
London and South Western,		6169	6041
Manchester, Bolton, and Bury,		672	573
Manchester and Birmingham,		3037	352
Manchester and Leeds,		4742	4228
Midland Counties,	10,264	2544	2424
Newcastle and Carlisle,		1264	1345
Newcastle and North Shields,	16,556	360	312
Northern and Eastern,	12,480	1615	1345
North Midland,		4133	3968
North Union,	2,387	985	931
Preston and Wyre,	1,108¼	179	137
Sheffield and Manchester,	20,691	522	282
South Eastern,	7,219	2052	
Ulster,	9,046	597	439
York and North Midland,	7,410	1596	1568

The entire length of these 44 railroads is only 1560 miles, whereas we

shall have within 15 years, a line of road, under a uniform system of management, of a thousand miles in length.

CANAL BETWIXT CAIRO AND SUEZ.

We learn, on the authority of a correspondent at Cairo, that the Pasha has determined on constructing a canal between that city and Suez, and that the work is to be commenced forthwith. It is expected that this undertaking will not prove so arduous as at first sight may appear; in many places all that is requisite to be done being merely to clear out the bed of the ancient canal; and as Mehemet Ali has now turned his sword into a ploughshare, it is not improbable he may find employment for some of his troops on the work. The following particulars of this ancient canal may not be uninteresting to our readers:

The great Sesostris appears to have been the first who conceived the project of uniting the Nile to the Red Sea by means of a canal, and actually commenced this gigantic enterprise, which, however, he did not finish. At a subsequent period it was resumed by one of his successors, Pharaoh Necho, on which occasion 120,000 men perished. It was not, however, then completed, in consequence of the response of the oracle, which was consulted by that monarch, to the effect that "the construction of the proposed canal would expose Egypt to the invasion of foreigners." During the dominion of the Persians, however, it was continued by Darius, the son of Hystas pes, and finally completed by Ptolemy Philadelphus, after whom it was named. The geographer Strabo relates that it "was furnished with ingeniously contrived sluices, which were opened to admit the passage of vessels, and afterwards very promptly shut." It was 140 miles long, 60 yards wide, and 30 feet deep. It commenced at the Pelusiac, or most easterly branch of the Nile, near Bubasatis, (about 35 miles north of Cairo,) and after flowing through the lake Amer, like the Rhone through the lake of Geneva, it terminated at Assinie, a town near the site of the modern Suez, By means of this canal, vessels from the Red sea, when they reach the Pelusiac branch of the Nile, could either descend to the Egyptian ports of the Mediterranean, or ascend the river to Memphis and Thebes. By furnishing an abundant supply of water for irrigation, it fertilized the desert on both sides of its banks, which were soon covered with opulent cities, among which may be mentioned Phagroniopolis, Heroopolis and Serapeum, the positions of which are indicated in our chart.

During the Roman dominion in Egypt, this canal was renewed or repaired by the Emperor Trajan, who added a branch to it, which communicated with the Nile near old Cairo. This prolongation of the canal bore the name of the Emperor, as is explicitly stated in the following passage: "Between Heliopolis and Babylon, (old Cairo) flows the river Trajan."

Our correspondent does not inform us whether it is in contemplation to renew the whole of these canals, or what deviation is contemplated in consequence of the Pelusiac branch of the Nile being now dried up, except that the point of junction with the Nile is to be at Shubra, in order that the city of Cairo may derive benefit from the undertaking.

We may add that, although our correspondent was assured on very good authority that the work is to be commenced immediately, he is rather skeptical as to the means possessed by the Pasha of carrying it into immediate execution.

Safe Travelling.—The Newburyport Herald says, that "On the 17th of June, ten thousand passengers were transported without the slightest ac-

cident, over the whole line of 100 miles of the Eastern railroad, by day and night. Eighteen regular trains beside some extras were run on the road, commencing at 4 o'clock in the morning and continuing until after midnight.

The following article, well worth the attention of engineers and others interested in the improvement of the locomotive, was sent to us several months ago, but by accident was not received. It has since been published in another journal, but as we are desirous of placing it upon our pages, we have thought proper to make this explaination.

LETTER FROM CHARLES MOERING, ESQ., ENGINEER, TO MESSRS. EASTWICK & HARRISON, LOCOMOTIVE BUILDERS CORNER OF TWELFTH AND WILLOW STS., PHILADELPHIA.

Gentlemen—In complying with your request to give you my opinion about your locomotive engines, I feel called upon to state the grounds that make this opinion what it is.

I do this in view of the interests of science, not intending to pass a mere encomium upon the productions of your establishment. Every engineer is, no doubt, conversant with the fact, that the power of a locomotive engine not only depends on the harmonious proportions of boiler and cylinders, and on the clever mechanical arrangement to work the pistons and transfer motion to the driving wheels; but every engineer must be also aware of the importance of another fact, viz: *the manner in which this power is made available in order to draw a maximum load, at a maximum speed, on a railroad.*

In examining this point, we find that a fulcrum is required to enable the steam power to act upon the weight, or the load to be drawn. This fulcrum in the locomotive engine, is evidently the grip of the driving wheels on the rails, meaning the friction between both, or *adhesion*, as it is technically called. Let a locomotive engine be ever so powerful, but take away the aforesaid friction, and the wheels will slip, the engine will draw nothing. This adhesion, derived from the pressure of the weight of the engine, must, therefore, bear a certain proportion to the latter. Its maximum will be obtained by throwing the largest, its minimum by placing the smallest amount of the engine's weight on the driving wheels. The minimum, however, has at no time been a desideratum, as the largest amount of adhesion is required for enabling an engine of a given power to draw a maximum load at a maximum speed.

In the six wheeled American engine, the true offspring of American mechanical talent, as possessing a fore truck, which affords a most opportune facility for turning curves, there is but *one* axle to bear the aforesaid proportion of weight; and this axle is the driving axle. On its position, therefore, depended the amount of weight to be made available for producing friction. As it was found impossible, as well as improper in practice, to place this *single* driving axle under the centre of gravity, for the purpose of equilibrating the entire weight of the engine, there remained but two other positions, viz: *behind and close before the fire box.*

To illustrate the effect in both cases, let us suppose two engines, A and B, each of 12 tons weight in running order, with cylinders, boilers and driving wheels of the same dimensions, and performing the same amount of duty on two roads of exactly the same kind.

In the engine A, with the driving axle *behind* the fire box, it was found that only *half* of its weight was brought into action for the purpose of pro-

ducing friction, amounting in this case to $\frac{12}{2}=6$ tons.

In the engine B, with the driving axle *before* the fire box, *two-thirds* were found available for the same purpose, equal to $\frac{2\times12}{3}=8$ tons. The ratio of *adhesion* is, therefore, A : B=6 : 8, meaning that the engine B possesses a surplus of two tons in its adhesive power, *and, consequently, in its capability of drawing loads.*

In further examining our subject, another question arises, concerning the effect of the given ratio of adhesion on the rails. In the engine A we have, as mentioned, six tons on the driving axle, and, therefore, three tons on each driving wheel. In the engine B, however, we find eight tons on the driving axle, and, consequently, four tons on each driving wheel. The proportion of *weight* on the rails is, accordingly, A : B=3 : 4.

Supposing these two engines to run at the same speed, S, and assuming the stress by impact upon the rails to be represented approximately by the speed multiplied into the weight imposed upon each driving wheel, then each line of rails would be percussed by A, with S×3=3S, and by B, with S×4 =4S.

This gives a ratio of *impact* A : B=3S : 4S or A : B=3 : 4; meaning, for the sake of practical illustration, that the engine B will ruin the rails, take them to be thirty-eight pounds per yard, after the lapse say of nine years; while the engine A will produce the same deterioration only after the space of twelve years, supposing the amount of traffic and other conditions to be the same in both cases.

Although no actual observations of this nature have been made with regard to the rails, yet the average duration of the wrought iron tires on the driving wheels, proves the above proportion not to be an incorrect one. The duration of tires on engines, with the driving axle *behind* the fire box, has been found to exceed the duration of those on engines with the driving axle *before* the fire box; and taking the latter to be nine months at an average, the duration of the first has been found to amount to from twelve to fourteen months.

Wronght iron rails being manufactured in the same way as tires, it can be but a fair assumption, that the duration of rails will admit of the same proximate scale given in the above proportion of impact.

This brief exposition, backed by the ratio of *tractive power*, A : B=6 : 8, and by the proportion of *duration*, A : B=3 : 4, makes it obvious why the *diminution of impact* in the engine B, possessing a superior power of traction, was found of such great importance, and has thus constantly occupied the attention of the American machinists and engineers. In pursuance of this notion, the eight wheeled engine was started with *two* driving axles, one *before* and the other *behind* the fire box.

Supposing such an engine C, to weigh twelve tons, in running order, and of the same dimensions as A and B, the weight on the two driving axles was found to be also *two-thirds*, or eight tons, yet pressing upon the road, on the four points of contact, only with $\frac{8}{4}=2$ tons.

The proportion of *adhesion*, or *tractive power*, is, therefore, A : C=6 : 8, B : C=8 : 8, A : B : C=6 : 8 : 8.

The ratio of *impact*, or *deterioration of the rails*, being C : A=2 : 3, C . B=2 : 4, C : A : B=2 : 3 : 4.

From this we may infer that rails lasting but nine years under the performance of the engine B, and twelve when traveled upon by the engine A, will not meet with their ulterior destruction before eighteen years, when engines of the kind C, are running upon them under the aforementioned suppositions.

I can, therefore, but applaud your resolution of building systematically no other engines but those with eight wheels—four driving and four truck wheels. However, I feel myself called upon to impress you with the advantages that must necessarily result when the number of driving wheels can be augmented to six or eight, without loosing that beautiful characteristic of the American engine, viz: *the free vibrating truck*, which in its office of piloting the engine along the track, I think invaluable for the American railroads, with their sharp turns and light superstructure.

An engine, D, with *three*, and an engine, E, with *four* driving axles, lending an opportunity to make their *whole* weight available for adhesion, which then would be that due to the maximum weight of twelve tons, in the given case, would certainly possess the greatest tractive power, and yet injure the road in a much less degree. The proportions of adhesion, or tractive power, would be the following ones, supposing in every case that the engine possesses sufficient power to slip her wheels in pulling against a fixed point, A : B : C : D : E=6 : 8 : 8 : 12 : 12; and the proportions of impact, or deterioration of the rails, B : A : C : D : E=4 : 3 : 2 : 2 : 1½.

I am aware of all the difficulties attending what I propose, but I feel, nevertheless, confident that "flexible coupling rods," permitting all the axles, with the exception of the main driver, to conform to the radii of curves, are within the pale of practical feasibility. Only on this condition should I think myself justified in preferring engines with a greater number of driving axles than two, were I even inclined to overlook the greater complication that such a mechanical arrangement must require. I reckon simplicity to be one of the cardinal virtues in any mechanical apparatus, and of the most absolute necessity in the locomotive engine.

After this digression, permit me, gentlemen, to come back to the *eight wheeled engine*, C, as the subject of my disquisition. Great as the improvement promised to be, in introducing the aforesaid engine, the advantages derived thereform for the preservation of the rails, were, however, nearly lost. The difficulty consisted in the stiff connection of the fire box, boiler, smoke box, and pedestals of the driving wheels, with the frame, which acted like a lever. Whenever one pair of driving wheels was raised, by some irregular elevation in the track, resulting from its bad condition, the other pair, in consequence of the springs not acting quick enough to force them down, were momentarily lifted up by the frame, consequently without bearing their due proportion of weight; and, on the contrary, when one pair was passing over a depression in the road, the other again, for the same reason, had to sustain nearly the whole amount of weight originally allotted to both driving axles—the truck wheels always acting as a fulcrum, and the frame, with its fixed pedestals and the axles therein revolving, as the lever.

This could not help injuring the road nearly in the same degree as the engine B; nay, the effects were still more injurious to the engine C, itself, as in the case of the main driving axle being suspended by the frame, in one of the aforesaid elevation or depressions of the other driving axle, the former received its rotary motion from the pistons without its fulcrum or adhesion to the rails.

It is but just to say, gentlemen, that you saved the eight wheeled engine from becoming a mere notion, and that owing to your exertions, it has been

brought to such a state of perfection as ought to make the old six wheeler, of the kinds A and B, quite absolete. It is furthermore, but justice to state, that your special adaptation of the lever, or balancing beam, to the use of locomotives upon railways, obviated the aforesaid difficulties in such a manner as to leave but little to desire; and here I regret to say, that some of the northern railroads in Germany—notwithstanding the unqualified recommendation of so able an engineer as Mr. C. E. Detmold—have not adopted engines with your improvement.

I consider the balancing beam, supported in its centre by a vertical shaft, resting on springs that are attached by the pedestals to the frame, and stayed on its ends by two vertical pins abutting against the two driving axles, as possessing, in an eminent degree, the two indispensable qualities—*first*, of equalizing the weight on both driving axles, in whatever condition the road may be, and, therefore, producing in an eight wheel engine of twelve tons, a constant and equal adhesion of eight tons, yet pressing the rails with but two tons; and, *second*, of furthermore diminishing the very ratio of impact as given above, the weight of the engine being suspended in the middle of the lever beam, causing it to fall only half the depth of any of the driving axles, in their passage over any short or sudden depression in the track, while the engines A and B must go down the whole depth, as supported by one axle alone, which by increasing the height of fall, must add to the power of the percussion, and, therefore, ruin the road even in a shorter period than the proportionate number of twelve or nine years.

But this is not alone what distinguishes your engines, the balancing beam of your arrangement being now used by nearly all the engine builders of note in the United States, after having purchased the patent right from you, which at once bespeaks the great merit and usefulness of your improvement.

It is, besides, the very simplicity of your engines that must engage the attention of even the least observing. Instead of four eccentrics, four eccentric rods, four latches, and a complicated arrangement to put them in and out of gear, by an extra hand lever, thus making three hand levers altogether, you have but two eccentrics, two eccentric rods, no latches, and a simple arrangement of the reversing valve; the whole to be handled by one and the same lever, and this, too, by moving it in exact accordance with the required movement of the engine.

It is true that in reversing you lose in speed, as the lead of the slide no longer takes place; but this loss I think of no moment, as it only happens when the engine is backing. Besides, the position of your forcing pumps is such as to prevent the freezing of the water, an advantage of great importance with locomotion in northern climes.

Gentlemen, this is my canded opinion about your eight wheeled engines, and you are welcome to make any use of this document. Permit me to avail myself of this opportunity to thank you for your readiness, and the frank and open way in which you satisfied my desire for information; and allow me to assure you that the modest and unostentatious manner in which you spoke of your engines, trusting more to their own merits than to puffing and boisterous recommendations, has most favorably impressed me with your own personal character. I am, gentlemen, your's, respectfully,

CHARLES MOERING,

Captain of Engineers in the Austrian Army.

Philadelphia, September 1st, 1842.

DESTRUCTION OF THE ROUND-DOWN-CLIFF BY GUN-POWDER.

You will not be surprised to hear that the announcement that an explosion

of 18,000 lbs. of powder was to be made in the Round Down Cliff this afternoon brought in an influx of stangers into this town; still, though considerable, it was not so large as I had expected. Curiosity was, I think, paralyzed by a vague fear of danger, which kept some thousands at home who might have witnessed it, as the event turned out, without the slightest shock to their nervous system. The experiment succeeded to admiration, and, as a specimen of engineering skill, confers the highest credit on Mr. Cubitt, who planned, and on his colleagues who assisted, in carrying it into execution.

Everybody has heard of the Shakspeare Cliff, and I have no doubt that a majority of your readers have seen it. I should feel it a superfluous task to speak of its vast height were not the next cliff to it, on the west, somewhat higher. That cliff is Round Down Cliff, the scene and subject of this day's operations. It rises to the height of 375 feet above high water mark, and was, till this afternoon, of a singularly bold and picturesque character. To understand the reasons why it was resolved to remove yesterday no inconsiderable portion of it from the rugged base on which it has defied the winds and waves of centuries, I must make your readers acquainted with the intended line of railway between Folkestone and this place.

At Folkestone there will be a viaduct of great height and length. Then there will be a tunnel, called from a martello tower near it, the Tower Tunnel, one third of a mile in length. Then comes a cutting through the chalk of two miles in length, called Warren's cutting. Then comes the Abbott's Cliff tunnel, one mile and a quarter in length, and now half finished, although only commenced on the 16th of August last. From the Abbott's Cliff tunnel to the Shakspeare Cliff tunnel the railroad will be under the cliffs close to the sea, and protected from it by a strong wall of concrete two miles long, and with a parapet of such a height as will not preclude passengers from the splendid marine view which lies under them. Now it was found that when a straight line was drawn from the eastern mouth of the Abbott's cliff tunnel to the western mouth of the Shakespeare tunnel, there was a projection on the Round Down cliff which must be removed in some way or other to insure a direct passage. That projection, seen from the sea, had the appearance of a convex arc of a circle of considerable diameter. It is now removed, and some idea of its size may be formed from the fact that a square yard of chalk weighs two tons, and that it was intended by this day's experiment to remove 1,000,000 tons. The Shakspeare tunnel is three-quarters of a mile long, and it is about the same distance from that tunnel to the town of Dover.

Having premised thus much as to the locality of Round Down cliff, I now proceed to describe, as briefly as I can, the means employed to detach from it such an immense mass of solid matter. A horizontal gallery extended for about 100 yards parallel with the intended line of railway, from which cross galleries were driven from the centre and extremes. At the end of these cross galleries shafts were sunk, and at the bottom of each shaft was formed a chamber, 11 feet long, 5 feet high, and 4 feet 6 inches wide. In the eastern chamber were deposited 5000 lbs. of gunpowder, in the western chamber 6000 lbs., and in the centre chamber 7000 lbs., making in the whole 18,000 lbs. The gunpowder was in bags, placed in boxes. Loose powder was sprinkled over the bags, of which the mouths were opened, and the bursting charges were in the centre of the main charges. The distance of the charges from the face of the cliff was 70 feet at the centre and about 55 feet at each end. It was calculated that the powder, before it could find a vent, *must* move 100,000 yards of chalk, or 200,000 tons. It was also confidently expected that it *would* move 1,000,000 tons.

The following preparations were made to ignite this enormous quantity of powder. At the back of the cliff a wooden shed was constructed, in which three electric batteries were erected. Each battery consisted of 18 Daniels' cylinders, and two common batteries of 20 plates each, to which were attached wires which communicated at the end of the charge by means of a very fine wire of platina, which the electric fluid as it passed over it, made red hot, to fire the powder. The wires covered with yarn were spread upon the grass at the top of the cliff, and then falling over it were carried to the eastern, the centre, and the western chamber. Lieutenant Hutchinson of the Royal engineers, had the command of the three batteries, and it was arranged that when he fired the centre, Mr. Hodges and Mr. Wright should simultuneously fire the eastern and western batteries, to ensure which they practised at them for several previous days. The wires were each 1,000 feet in length, and it was ascertained by experiment that the electric fluid will fire powder at a distance of 2,300 feet of wire. After the chambers were filled with powder, the galleries and passages were all *tamped* up with dry sand, as is usually the case in all blasting operations.

At 9 o'clock A. M., a red flag was hoisted directly over the spot selected for the explosion. The wires were then tested by the galvanometer, the batteries were charged, and every arrangement completed for firing them.

It was arranged that the explosion should take place at 2 o'clock; at that time there was an immense concourse of people assembled. In a marquee erected near the scene of operation, for the accommodation of the directors and distinguished visitants, we observed among the number assembled, Sir John Herschell, General Pasley, Colonel Rice Jones, Mr. Rice, M.P., Professors Sedgwick and Airy, the Rev. Dr. Cope, and there was also a strong muster of engineers, among whom were Mr. Tierney Clark, Mr. John Braithwaite, Mr. Charles May, Mr. Lewis Cubitt, and Mr. Fred. Braithwaite; the engineers and directors of the Greenwich, Croydon, Brighton, and South Eastern railways, besides numerous foreigners of eminence.

At 10 minutes past 2, Mr. Cubitt, the company's engineer in chief, ordered the signal flag at the western marquee to be hoisted, and that was followed by the hoisting of all the signal flags. A quarter of an hour soon passed in deep anxiety. A number of maroons, in what appeared to be a keg, was rolled over the cliff, and on its explosion with a loud report, all the flags were hauled down. Four more minutes passed away, and all the flags except that on the point to be blasted were again hoisted. The next minute was one of silent and breathless and impatient expectation. Not a word was uttered, except by one lady; who when too late, wished to be at a greater distance. *Galeatum sero duelli pœnitet.* Exactly at 26 minutes past 2 o'clock a slight twitch or shock of the ground was felt, and then a low, faint, indistinct, indescribable moaning subterranean rumble was heard, and immediately afterwards the bottom of the cliff began to belly out, and then almost simultateously about 500 feet in breadth, with reference to the railway's length of the summit began gradually to sink.

There was no roaring explosion, no bursting out of fire, no violent and crashing splitting of rocks, and what was considered extraordinary, no smoke whatever; for a proceeding of mighty and irrepressible force, it had little or nothing the appearance of force. The rock seemed as if it had exchanged its solid for a fluid nature, for it glided like a stream into the sea, which was at a distance of about 100 yards, perhaps more, from its base, tearing up the beach in its course, and forcing up and driving the muddy substratum together with some debris of a former fall, violently into the sea, and when the mass has finally reached its resting place a dark brown color was soon

on different parts of it, which had not been carried off the land; the shattered fragments of the cliff are said to occupy an area of 15 acres, but we should judge it to be much less. I forgot to minute the time occupied by the descent, but I calculate that it was about four or five minutes. The first exclamations which burst from every lip was, "Splendid, beautiful!" the next were isolated cheers, followed up by three times three general cheers from the spectators, and then by one cheer more. These were caught up by the groups on the surrounding downs, and, as I am informed, by the passengers in the steamboats. All were excited, all were delighted at the success of the experiment, and congratulation upon congratulation flowed in upon Mr. Cubitt for the magnificent manner in which he had carried his project into execution.

As a proof of the easy, graceful and swimming style with which Round Down Cliff, under the gentle force and irresistible influence of Plutus and Pluto combined, curtseyed down to meet the reluctant embraces of astonished Neptune, I need only mention that the flagstaff, which was standing on the summit of the cliff before the explosion took place, descended uninjured with the fallen debris.

No fossil remains of the slighest importance were brought to light, which was a matter of disappointment to many. A very few even of the most ordinary character were found among the mass, which it may well be imagined was soon after the explosion, teeming with the curious multitude from the cliffs above, anxious to obtain some relic of the event.

On examining the position occupied by the debris of the overthrown cliff, we were much pleased to find it more favorably disposed than we could have conceived possible. Instead of occupying the site of the proposed railway at the foot of the cliff, it had by its acquired velocity slid past it, and left comparatively little indeed to be removed. At some considerable distance from the cliff, the fragments appeared to be heaved up into a ridge, higher than any other part, forming a small valley towards the cliff, and another seaward, beyond which a second ridge appeared, when it finally slopes off towards the sea. The chalk was by no means hard, and appeared thoroughly saturated with water. The great bulk of the fragments ranged from about two to perhaps eight or ten cubic feet, although we observed a vast number of blocks, which contained from two to three cubic yards and upwards, one of which was driven some distance into the Shakspeare tunnel without doing injury to the brickwork. There was very little, indeed, of what might be termed rubbish in the mass.

Previous to the explosion, we had heard it stated that about a million yards were expected to be detached; indeed the Railway Times so stated it, on the 21st ultimo, apparantly from authority, and after the explosion took place, it was publicly asserted by one of the officials, that three quarters of a million of cubic yards had come down. Now, on cubing the stated dimensions of the mass, which were given as under 300 feet in height by say 50 feet longer than the gallery, which would therefore be 350 feet, by an average thickness or depth from the face of the cliff of 60 feet, we shall have 233,333 cubic yards; but as the present face slope of the cliff is greater than before, the average thickness perhaps might be increased to 75 feet, which would make the quantity 291,666 cubic yards, from this is to be deducted 50,000 yards, the estimated quantity to be now shifted in forming the road, we shall then have 30,000 yards effectively removed by the expenditure of one ton of powder. We understand that Mr. Cubitt, the engineer, afterwards stated that a saving of six months' work and £7,000 expenditure was effected by this blast. Now allowing 6d. per yard for the removal of the quantity now

required to be shifted, which would amount to £1,250, and £500 for the powder used in the blast, the cost of forming the galleries, tamping, etc., we shall find that this mass has been removed at a cost of 1·44 pence per yard. Again, taking Mr. Cubitt's statement, that a saving has been effected of $7,000, to which, if we add the £1,750, expenditure by the present plan, we shall find that he estimated the cost of removal by hard labor, at rather less than 7½d. per yard.

We felt an interest in examining the beds and fissures of the chalk in the neighborhood of this blast, which clearly indicated that the plan of removal adopted by Mr. Cubitt, was not only the cheapest, but the safest method which could have been adopted. The vertical fissures which here traverse the chalk appear to lie pretty nearly parallel, and at a slope perhaps of one-fifth to one-tenth to one. It was in one of these fissures that the whole mass parted and slipped down, on which we believe it had set previously, no doubt brought about by the infiltration of water more than the sapping of the base by the sea. So treacherous, indeed, was this chalk, that if we are rightly informed, a mass equal nearly in bulk to that blasted on Thursday came down unexpectedly some time since in the night time, burying in its ruins a watchman or foreman belonging to that part of the line. In the zigzag gangways cut along the face of the cliff, to enable persons to ascend to the summit—this sliding of the chalk where those vertical fissures are intersected, appears very frequently, inspiring the passer-by with a feeling of great insecurity. How far the water might be intercepted, or otherwise be prevented from filtering through these fissures is a question of great importance, and would not, we think, be one of difficult remedy. It also becomes a matter of interesting inquiry as to the effect which a lesser quantity of powder would have had, deposited and fired in the same manner. Would it only have made the mass insecure, or caused a partial sliding down, rendering it then more difficult of removal by hand than at first? The proportion of powder which Mr. Cubitt employs in his blasting operations we understand is determined thus: "The cube of the line of least resistance in feet, gives the quantity in half ounces;" but in this case there does not appear to have been any such quantity employed, though much more than heretofore is found necessary in usual blasting operations. Perhaps the most curious circumstance, connected with the operation, was the apparent absence of shock on the firing of the charge on some spots in the immediate vicinity, while at other, far more distant, it was clearly perceptible. Thus, where the batteries were placed, those in charge of them thought the charge had missed fire, from their being insensible to any shock, while at five times the distance along the face of the cliff, it was clearly felt. But even along the face of the cliff it was very evident that the shock was felt by some and not by others, though standing within a few yards of each other.

Junction of the Rhine and Danube.—The canal connecting these two great rivers of Europe, was nearly completed at the last accounts. It was to have been opened for navigation in a few days, between Nuremburg and Bamberg, and shortly after, through its whole extent, from Danube to Mayn.

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AMERICAN

RAILROAD JOURNAL,

AND

MECHANICS' MAGAZINE.

No. 4, Vol. I. Third Series. | APRIL, 1843. | Whole No. 423, Vol. XVI.

The resolution of the legislature of New York calling for information from Railroads, is given below. This movement will procure the annual publication of a series of returns, similar to those made to the Massachusetts legislature, and which have materially influenced the character of railroads by presenting in a condensed form the *accurate* results of each years' operation—which results have uniformly proved highly favorable to the reputation of railroads. Viewed in this light we may pronounce this an important step in the progress of railroads in our State.

STATE OF NEW YORK. IN ASSEMBLY, FEBRUARY 2, 1843.

On motion of Mr. Hathaway—*Resolved*, That the several railroad companies in this State be and are hereby required to make their annual reports to the Secretary of State, by the first day of February in each year, which reports shall embrace the business of the preceding year to the first day of January, and shall state the length of their road in operation; cost of construction; income from passengers, from freights and from all other sources; the number of through and way passengers, and the receipts from each class; their expenses for repairing and running the road and for construction, which two items shall include all their expenditures; the amount of dividends; the number of locomotives; of passenger, freight, mail and other cars; the number of machine shops; the number of horses; the average number of men in the employment of the company; the number of miles run by passage trains, by freight and all other trains; and that the Secretary of State be requested to put such information in a tabular form, and prepare it and the reports in one document, for printing, for the use of the legislature.

Resolved, That the Secretary of State be requested to communicate the foregoing resolution to the Presidents of the several Railroad companies in this State. By order. H. N. WALES, *Clerk*.

State of New York, Secretary's office. I certify the above to be a true copy from the original on file in this office.

(Signed,) S. YOUNG, *Secretary of State*.

The proceedings of the Railroad Convention lately held at Albany, are deserving of notice in the pages of this Journal, as showing a design to ac-

commodate the public by frequent trains and low fares. An attentive examination will show no spirit or disposition to anything improper

At a meeting of Delegates from the several Railroad companies between the Hudson river and Buffalo, held at the American hotel at Albany, on the 31st day of January, 1843, pursuant to notice, H. B. Gibson was apointed president, and Charles Stebbins, secretary.

The following Delegates appeared, viz:

Attica and Buffalo—H. Hawkins, V. R. Hawkins, J. P. Veeder.

Tonawanda—H. J. Redfield, Jona. Child.

Auburn and Rochester—H. B. Gibson, J. Fellows, D. S. Skaatts, Chas. Seymour, Robert Higham.

Auburn and Syracuse—G. B. Throop, T. Y. Howe, Jr., E. Williams

Syracuse and Utica—J. Wilkinson, Holmes Hutchinson, A. Burt, C. Stebbins.

Utica and Schenectady—E. Corning, L. Benedict, W. C. Young.

Mohawk and Hudson—S. Stevens.

Troy and Schenectady—R. P. Hart, and B. Marshall.

Resolved, That Mr. Weld of Boston, be invited to attend this convention as an honorary member.

Resolved, That a committee of one from each delegation be appointed by such delegations to report upon the subjects to be acted upon by this convention and that such committee report at 3 o'clock, P. M.

The following committee were appointed, H. Hawkins, J. Child, H. B Gibson, T. Y. Howe, J. Wilkinson, L. Benedict, S. Stevens, R. P. Hart.

The following resolutions were reported by the committee and adopted by the convention.

1. *Resolved*, That it is expedient to run the daily lines between Buffalo and the Hudson river connecting with the morning and night boats on the Hudson river out of Albany and Troy and that each line be run in 25 hours, including stops and that the same be apportioned as follows:

Buffalo to Rochester 6 hours—Rochester to Auburn 6 hours—Auburn to Syracuse 2 hours—Syracuse to Utica 4 hours—Utica to Albany and Troy 7 hours—25 hours; and that the time of starting from each end of the road for the two trains be as follows:

Buffalo	6 A. M.	Albany and Troy,	6 A. M.
"	4 P. M.	Schenectady,	8 A. M.
		Albany and Troy,	7 P. M.
		Schenectady,	9 P. M.

2. *Resolved*, That passengers ought to be allowed to pay their fare and direct their baggage to such places upon the route as they may deem proper, and that the superintendent of the several roads be directed to devise and execute a system to carry out this resolution under the executive committees of their roads.

3. *Resolved*, That baggage masters be employed at the joint expense of the several companies between Albany and Buffalo, to accompany each train and ticket and take charge of baggage between those points, who shall be paid by each company in proportion to their length and amount of receipts, and that the details of the plan to carry out this arrangement be referred to the superintendents of the several roads.

4. *Resolved*, That it is expedient that the car houses on the line between the Hudson river and Buffalo, inclusive, should be closed, and the passengers relieved from the press and inconvenience of being crowded, in the several car houses by persons who may resort there from curiosity.

5. *Resolved*, That it is expedient that a third run be made between the Hudson river and Buffalo, leaving the Hudson river at 10 o'clock P. M., and Buffalo at 12, noon, at uniform prices of 2½ cents per mile for one description of cars, and 1½ cents per mile for emigrant cars, and that it be referred to the superintendents of the several roads, under the direction of the executive committees, to arrange the arrivals and departures at the intermediate points on the line, and other matters in connection therewith.

6. *Resolved*, That the superintendents of the several companies, under the direction of the executive committees, devise and carry into effect a system of taking fare through the line, each way, for all the trains, of conveying and ticketing baggage, and such system for securing the emigrant travel as may be necessary.

7. *Resolved*, That a committee of one from each company be appointed by the delegates now present, to consider and digest a plan of stocking the passenger, baggage and freight cars, on the line between Albany and Rochester; and ultimately, when the line is completed, to Buffalo; and report the same to their several companies for consideration.

8. *Resolved*, That during the winter months, the train shall leave Buffalo at 7, A. M., and reach and remain over at Syracuse; and leave Albany at 9, A. M., and stay over night at Auburn; so that the passage between Albany and Buffalo may be made in two days, and that it be referred to the superintendents of the several roads, under the direction of the executive committees, to carry this out, and this to take effect on Monday, the 6th February instant.

9. *Resolved*, That a copy of the proceedings of this meeting be furnished to each company.

10. *Resolved*, That the two first lines commence on the 15th of March next, and the third line on the opening of the canal.

11. *Resolved*, That the several companies should be responsible to each other for all money received by their respective receivers, who are severally appointed by such companies.

12. *Resolved*, That the several companies upon the railroad line will not employ persons in the business of transportation who ever drink intoxicating liquors.

13. *Resolved*, That this convention deprecate the practice of employing runners at a distance from the respective railroads as destructive to the interests of the stockholders and vexatious to the travelling public, and that so far as in our power, we will use our influence against any company who shall hereafter employ any runner or agent at any other place than on the line of the road, at or near their depot.

14. *Resolved*, That the superintendents of the several roads be specially charged with the duty of giving extensive circulation by publication as may be deemed necessary, of the times of running such train and the prices between Albany and Buffalo, through the United States, at the expense of the several companies, in proportion to their length and amount of receipts, and that the proceedings of this convention be published in the papers of this city.

The convention adjourned without day.

H. B. Gibson, *President.*

C. Stebbins, *Secretary.*

LEGISLATIVE INTERFERENCE WITH RAILROAD MANAGEMENT.

A bill relative to railroads, having been reported in the legislature of this State, which seems to us one of the most monstrous absurdities of the day.

we have thought proper to place upon record our sentiments, although we entertain no doubt as to the ultimate fate of the measure.

The report and bill seem to be founded upon petitions setting forth the suspicion of a hideous combination between certain railroads, to cheat the *people*, to play into each others hands, and finally, to do something dreadful —we do not exactly know what, but the report appears to apprehend the subversion of the State government.

The main points of the report are as follow:—All combinations of *natural persons* are suspicious; when the rights of others are to be, or *may be* injuriously affected, they are illegal.—Corporations are not exempt from the liabilities of individuals. Then follows an illustration, drawn from monied institutions, which would equally apply to temperance societies.—Moreover railroad companies can give free rides to Editors, Judges and Legislators, and so bribe them. The use of motive power, etc., belonging to one company, on the road of another, forms a "union of strength and power which cannot be controlled, and is beyond the reach of every legitimate power known to the government." The gullability of the travelling public, is such, that they may be induced to purchase tickets for a road over which they do not desire to travel. Passengers may be "*seduced*" even from the decks of canal boats.

To obviate all these evils, the bill proposes to enact, that the fare prepaid for any road may be demanded back within 20 minutes after arriving at the end of the previous road; that whenever two roads unite, in all cases, a stop of 30 minutes must be made; that equal facilities (?) be granted by every railroad between the Hudson river and lake Erie, to every other railroad, for the purpose of procuring, carrying and transporting passengers, etc.; that there shall be admitted to the car house of each company two runners of any railroad, steamboat, packet boat or stage line; but that these runners shall not, under the penalty of a misdemeanor, solicit passengers!!! The bill further provides, that every car for passengers shall have glass windows —be lighted by night, and have "*comfortable cushioned seats with cushioned backs*"—that these cars shall always be run in the rear of every baggage, freight, or mail car. It finally provides that each company shall use none but its own cars, motive power, etc., under the penalty of $200.

Such are the provisions of the bill, which might be styled, a bill to interfere with railroad management—to incommode travellers—to patronise runners—to prevent the transportation of emigrants, and "to give every thing to every body."

Since our examination of this document, we have received the remonstrance against it by the companies on the line, from Schenectady to Buffalo. There is much good sense in this paper, and we give below, several passages which show the folly of any interference, although there are many points upon which we hardly think any argument need have been offered, unless to rebut absurd charges. We are averse from meddling with the politics of these matters, but we certainly hope that such proceedings may here-

after be rare, both for the safety and comfort of the travelling public, as well as for the credit of our State.

"The term monopoly has become of very general use and application, and is quite common in respect to railroads. When a measure, an improvement, or in short anything, is objected to because it is a monopoly, it may be well to consider whether its being so is a part of its nature, and essential to its continuance, or whether it can be divested of this feature and still be useful, available, or capable of existence.

It is the law, or a grant, that gives a monopoly character, if anything does. Now we suppose that no law can relieve a railroad in this respect, unless it destroys it. We doubt not, that all those who object to railroads, as monopolies, do not urge this because they wish all railroads destroyed, but from a want of reflection. The railway including its motive power, passage and freight property, is altogether a single machine or power; and it is as impossible for any foreign association or individual to come in and use it, as they or he please, as for two different sets of men to manage a steamboat at the same time, each resolved to go their own way. A single power and policy is necessary to control and operate a railway successfully.

To object to it therefore, because it is a monopoly, is either saying, that the individual making the proposition ought to come in and have his way upon it, and thus for the time be himself the monopolist, or that the thing itself should be abandoned because he cannot have what he conceives to be his share in the monopoly."

"The great bulk of the capital of railroad companies is invested in the road-bed and the tracks, where it remains incapable of transfer, and only productive by having the largest amount of business done over it. Several companies, upon the same line of railway, must necessarily manage in harmony; or the use of the line, to the public, is lost. This is so unlike the operation of moneyed or other corporations, that, to deduce the power, or the danger of their uniting *their* capitals, because the several companies upon the railroad line from the Hudson river to Buffalo, by acting in harmony, seek to make the passage in 25 hours, must be by a course of reasoning too attenuated for ordinary comprehension. To denominate the measures which railroad companies, upon a continuous line, must adopt as combinations, or confederacies, is such a misapplication of terms as want of knowledge, or the rival feelings of competing lines can only account for.

The application of such terms to this railroad line may be made with equal force against the arrangements from Albany to Boston, or to the New York and Erie railroad, or to the forwarding lines from Chicago to New York; in short, to every line of transportation through the country. Why can property be carried proportionably cheaper from New York to Chicago, than it can for short sections upon the same route? We suppose that it is entirely on account of the connected arrangement that is made."

"The railroad companies are under great responsibility in their business, for the proper care of the persons and property of their passengers, and they have found that to produce the largest accommodation they must adhere to rules, which may sometimes seem to be unfavorable to individuals, but which experience has shown are salutary. It requires skill, and a thorough knowledge of the business, to operate an important line of railroads."

"Although the bill alluded to does not propose to require the baggage to be overhauled at each termination, yet it contains provisions which may make that necessary in the most inconvenient manner. As the trains run day and night during the business season, some of them arrive at all the large towns

during the night, and at such arrivals very few of the passengers wish to leave the cars, and still fewer desire any arrangement that turns out their baggage or subjects them to the necessity of looking for it.

"It requires at all times great care to keep the baggage from being left or from going astray, and all the arrangements as to the baggage have for their first object security.

The large towns and all the lines of communication are known to be constantly infested with pickpockets and vicious persons who are continually depredating upon travellers, who would enjoy a harvest if at every arrival at a car house the baggage of passengers may be overhauled and they are to seek new seats. Suppose such a person in the train and he has his baggage put at the bottom of a wagon or car by design, and on his arrival at some convenient place he demands it; all the baggage must be taken out to find his, and in the mean time (for it will likely be night,) one or more trunks are stolen as he had designed should be the case. Usually it takes several cars to hold the baggage, generally not less than three; and if these are to be unloaded in the night in the presence of all who choose to mix with the passengers, it has been, as it always will be, found to be impossible to avoid difficulties resulting from accident or design. In all such cases travellers do not feel safe, for the reason that experience has shown that they are not so.

Suppose under the power which the bill professes to give him, that a pickpocket shall demand his baggage, and while searching for it that a trunk is stolen, (most likely by an accomplice,) shall the railroad companies bear the loss?"

"If the railroad companies are left free, as to the employment of runners or such agents, they will not employ them, but if they are to be licensed or recognised by law, as an appurtenant to the passage business, it would almost seem that all parties, in self defence, must employ them."

"A single suggestion as to a matter not strictly germain to the question involved, but brought in aid of the restrictions proposed in the bill, will close our memorial. It is urged that other competing lines, by a payment of tolls on passengers, are a source of revenue to the State. It would give the argument greater force if the State had not constructed, and did not keep in repair, the avenue in which their passage business is done. In short, if the State did not furnish the capital mainly for one mode of competition, and leave the other to individual contribution.

The railroad companies enjoy no immunity from taxation. The assessment rolls, the highway commissioners' lists, and the school district records in every town through which the railroads extend, will show how fully they share in the public burthens. It would be much to their interest to pay a toll on passengers equal to that paid upon the canal, and be exempted from other taxation. To impose a toll without such an exemption, would be perhaps more in the light of a bonus than otherwise.

In some towns the railroad companies pay a large share of the whole taxes, because a great amount of capital may have been expended there in cutting through ledges of barren rocks, or in crossing a deep morass. In some school districts they pay the largest part of the taxes for building houses and maintaining schools.

We entertain much confidence that the towns through which the railroads extend will not raise the objection that they pay less than their fair share of taxes.

RAILWAYS AND CANALS IN ENGLAND.

Herapath's Journal and Railroad Magazine, of 4th February last, contains "the railway and canal traffic returns of England, compiled from offi-

cial sources," in tabular form, and presents some facts highly interesting to the friends of internal improvement.

The number of railways completed and in operation in Great Britain, stated in the table, is 39, and their length, 1456 miles. The capital and loans authorized for their construction, is £55,576,976. The amount actually expended, is £52,290,024—equal to $261,450,120, or nearly $180,000 per mile.

All the main and long lines of railway, in England, without exception, pay dividends of from 1 to 10 per cent., keeping themselves in perfect order, with a "reserved fund" for this object. The short roads do not pay dividends in the same proportion. This is owing in a great measure, to their extravagant cost. The London and Greenwich railroad, 3¾ miles in length, cost $4,954,000, or $1,311,000 per mile, and divided 1¼ per cent. per annum.

The London and Blackwell railroad of the same length, cost £1,071,715, or $1,418,400 per mile, and divided the last year 2 per cent., on this immense outlay.

Name of Railway.	Miles.	Cost.	Cost per mile.	Value of Stock.	Dividends.
Great Western,	118½	£ 6,350,000	£54,529	93 per cent.	6 pr.ct.
Liverpool and Manchester,	31	1,438,654	46,408	192 "	10 "
London and Birmingham,	112½	5,832,254	51,842	212 "	10 "
Grand Junction,	97½	2,273,344	21,704	200 "	10 "
Stockton and Darlington,	43½	2,000,000	46,000	255 "	7½ "
Dublin and Kingston,	6	340,000	56,710	100 "	5 "
Manchester and Leeds,	6	2,913,000	57,120	100 "	5 "
	414	£21,147,252	£52,021 average.		

The cost of these roads is to be attributed, mainly, to the reduction of their grades to as near a level as the nature of the country traversed will permit. This rule is now to a great extent abandoned. The right of way, with legal and parliamentary expenses, also the embelishment to depot warehouses etc., are items of greater expense than in this country.

The seven railways above enumerated, yield the best returns. The other 32, costing £31,142,776, vary in their dividends, from 1 to 6 per cent., and are generally short roads.

It would appear that 414 miles of railway in Great Britain, has cost $250,000 per mile, or equal to three times the cost per mile of the 4000 miles of railroads completed in the United States. The average cost of the continuous line of 625 miles of railroad from Portland in Maine, to Buffalo or lake Erie, has cost within £6000, or $30,000 per mile. The average nett income on this line of 625 miles, may be safely stated at 7 per cent., although the Western railroad of Massachusetts, costing $7,566,791, for 156 miles of road, has only yielded the first year after its completion, about 4 per cent. The Utica and Schenectady railroad, and the Utica and Syracuse railroad, and the continuous line to Buffalo, has yielded from 7 to 12 per cent. nett.

The railway system in New England, may be considered eminently suc-

cessful, and is now a favorite investment, having the preference over bank stocks.

In England, the canals, from being a part of, and working in connection with railways and manufactories, have not been materially injured by the introduction of railways. It is true canal stocks have fallen much in value from what they were, prior to the introduction of railways. For *permanent investments*, the canals in connection with large manufactories and coaling districts, are in great repute, and have a value with their proprietors, much beyond their ratio of dividends. The Loughborough canal, gives 60 per cent. dividends, and is worth £1350 for £100 paid, or £94,500, for £10,000 paid out for its cost. The Trent and Mersey canal, that cost £130,000. yields 65 per cent. dividends and is worth £1000. for £100 paid.

It is stated that 36 canals—all the canals of Great Britain—cost £6,800,000. This is a sum not much exceeding the amount expended by the State of New York in canals, but with a very different result. This arrises from the scattered population in this State, compared with the dense population in the manufacturing districts of Great Britain, with the necessity of their use, to convey the raw materials of cotton etc., to the manufactories. This, added to the enormous amount of coal, iron, and various ores transported to the manufactories, and principally by those who own the canals, is the cause of their great value. It will take centuries to produce the like results in the United States. In the mean time, railways from their facilities in connecting distant districts and overcoming mountain barriers, are daily acquiring warm advocates, both in this country, and England. They have in fact, become indispensable for the transmission of our mails. They should merit the fostering care of the general government, instead of the abuse bestowed upon them by some incumbents of the heads of departments. For national defence, their value cannot be estimated or questioned.

J. E. B.

RAILWAY TRAFFIC.

The following calculation taken from the last weekly returns, of the first week in February, of 39 railways, in length 1456 miles, taken from Herapath's Journal and Railway Magazine, will be found highly interesting, when considered that the month of February in England, as well as this country, is not comparatively one of travel and traffic.

The number of passengers on 26 railways, was 233,551. The total for the week was about 500,000. The receipts on 39 railways, was £52,704, ditto for goods, £19,980, total, £72,684. This is an average of near £50 per mile per week. The traffic, therefore, is certainly at the rate of twenty-two millions of dollars per annum, and carrying twenty millions of passengers.

This practical view of the benefits of railways, in *gaining time*, and the transmission of a passenger, at five or six times the average speed of the stage coach, or canal, will make this class of improvement popular and indispensable.

J. E. B.

EXTRACTS FROM THE REPORT OF THE WESTERN RAILROAD.

The completion of this important work renders it necessary that we should record the principal information in regard to cost of construction—magnitude of the work, etc., as set forth in the report to the Massachusetts legislature.

The receipts and expenditures for the last year will be found in the table already given in our February number.

STATISTICS OF CONSTRUCTION.

The statistics required by law in the report, after the road is opened for use, are hereto subjoined, so far as they relate to its *construction.* And the undersigned add, also, in this connection, other data, which may prove useful or convenient for future reference.

The *length* of the Western railroad is as follows, viz: From its junction with the Boston and Worcester road, near the depot of this company, in Worcester, to the east abutment of the Connecticut river bridge, is

	Miles. Feet.		
	54.3680	or	54.697
From thence to the line of New York,	63.0568	"	63.107
Total,	117.4248	or	117.804
The length of the Albany and West Stockbridge road, from the State line to the face of the Greenbush dock at the Hudson river, is	38.1180	or	38.224
Total of both roads made by this company,	156.148	or	156.028
The length of the Worcester road from their passenger depot in Boston, to its junction with the Western, is	44.320	or	44.060
Total from the depot in Boston to the Hudson river,	200.468	or	200.089
Add from Greenbush dock to Albany shore,	1.415		268
Total from depot in Boston to ditto,	200.1883	or	200.357

ELEVATIONS.

For these, the *base line* of the Worcester company is assumed, it being the grade of that road, across the mill-dam basin in Boston, and the following are the elevations *above* that base line.

	Feet.
The depot of this company at Worcester,	476.83
The Charlton summit (between Worcester and Connecticut river,)	906.75
The depot at Springfield,	70.91
The summit in Washington (between the Connecticut and Hudson rivers,)	1,456.51
The track at the State line,	916.07
The summit in Canaan (between the State line and Greenbush,)	954.61
The depot in Greenbush,	26.11
Thus it appears, that the summit in Washington is the highest elevation of the road, and that this is above the depot at	
Worcester,	979.68
Springfield,	1,385.60
Greenbush,	1,430.40
and above the base line of the Worcester road, in Boston,	1,456.51

PLANES.

Upon the Western road there are separate planes 142, of which are

level,		12
ascending west,	83	
descending west,	47	—130

The grades of the road vary from level to 83 feet per mile. The apportionment is nearly as follows:

From	1 to 20 feet	33	miles.
	21 to 45 "	44	"
	46 to 60 "	11	"
	68 to 83 "	14	"
	Level,	7¼	"

Between 68 and 83, there is one plane of 5 to 6 miles of 74 feet grade, and 2 grades making over 4 miles of 79 feet.

The following table shows the number of curves, with the different radii in feet, and the lengths of the different classes in feet and miles:

TABLE OF CURVES ON THE WESTERN ROAD.

Number of Curves.	Length of Radii in Feet.	TOTAL LENGTH OF EACH CLASS	
		In Feet.	In Miles.
25	22,920 to 5,730	39,887	7.5542
90	5,730 to 2,865	121,736	23.0509
59	2,865 to 1,910	72,651	13.7590
19	1,910 to 1,432	26,479	5.0333
17	1,432 to 1,042	26,054	4.9338
1	of 1042	1,500	0.2840
1	955	910	0.1723
1	882	490	0.0928
	length of straight	289,707	54.8687
	line,	332,297	62.9352
		622,004	117.8039

The shortest curves are severally of radii of 955 and 882 feet, and they are at each end of the Tuttle Bend bridge, on the north line of Russell.

The whole number of planes on the Albany road, is		82
Of which are level,		28
Ascending west, (total ascent, 79½ feet,)	18	
Descending west, " 971 "	36	54—82

The following table shows the inclinations in feet per mile, and the lengths of each class of gradients:

Number of Planes.	Inclinations in Feet per Mile.	Total length of each Class.
2	0 to 10	0.284 miles.
17	10 to 20	5.663 "
10	20 to 30	3.362 "
16	30 to 40	17.727 "
9	40 to 44.88	9.053 "
28	Level.	2.135 "
82		38.224 miles.

TABLE OF CURVES ON THE ALBANY ROAD.

Number of Curves.	Length of Radii in Feet.	Number of Curves.	Length of Radii in Feet.
20 of	6000 and upwards	10 of	3000 to 2000
11	6000 to 5000	13	2000 to 1000
5	5000 to 4000	1	859½
7	4000 to 3000		Total degrees of curvature, 1869.

Total curved line, 20.464 miles.
" straight line, 17.760 "
" 38.224 "

The whole length of main track laid on the Western road is	miles,	117.804
Length of turnout and depot tracks,	"	8.961
Total tracks laid on Western road,	"	126.765
The main track laid on the Albany road,	38.224	
Turnout and depot tracks, laid and in progress	5.750—	43.974
Total tracks laid by this company	miles,	170.739

A single track only has been laid down on both roads, with the necessary turnout and depot tracks at the stations.

On both roads, the edge rail of the T pattern, has been used (excepting on a few recent side tracks,) weighing 56½ pounds to the linear yard; supported by wooden sleepers, principally of chestnut, 7 feet long and 7 inches through, at distances of 3 feet from centre to centre. These sleepers rest on longitudinal sills of plank 8 inches by 3, with a short piece of the same 3 feet long, under them at their joints, and 4 additional pieces, 3 feet long, under the sleepers, at the joints of the iron rails. On a part of the Albany road, the sleepers nearest the joints of the iron rails are 2½ feet from centre to centre, with six instead of five sleepers to each rail; and the two sleepers nearest the centre of the iron rails have 2 short pieces, each 5 feet long, under them, to increase the bearing surface.

A small part of the turnout and depot tracks recently laid down on the Western road, and used only to deposit cars and trains upon, are of a lighter iron rail, purchased of the Lowell company, of the "*fish-belly*" pattern.

WIDTH OF GRADES.

The greater part of the Western road has been graded to a width of 20 feet in the cuts and 16 feet on the embankments, for a single track. The deep cuts and high embankments, generally, have been graded to a width of 30 ft in the cuts and 26 on the embankments, for a double track. The heaviest rock cuts are of double width; and the masonry is all for double track, except that of the Connecticut river bridge, and a few of the smallest structures.

The whole of the Albany road between Greenbush and Chatham, 23 miles, and a part of the remaining 15 miles, is graded for two tracks; the former, in the cuts, from 26 to 34 feet, and on the embankments, from 22 to 26; the latter 15 miles, in the cuts, 20 to 34 feet, and on the embankments, 16 to 26; and where graded for a single track, the earth cuts are from 20 to 24 feet, and the embankments from 16 to 20. The rock cuts, 26 feet wide, and the masonry, are all for two tracks. The portion of the road between Greenbush and Chatham was made of full width, with a view to its union with the New York and Albany road at or near the latter place, if that should be constructed.

BRIDGES.

The railroad bridges east of Connecticut river, are constructed of truss frames, after the plan of Long's patent, and are made for two tracks. The Connecticut river bridge, and those westward of it, on the Western road, are of truss frames, of Howe's more recent patent, and they are constructed for one track only. The truss frames of all are covered in on the sides and top, and thoroughly white-washed. The entire flooring of the Connecticut river bridge is covered with tin, painted of a dark color. This bridge is 1264 feet long, of 7 spans, 180 feet each.

The whole length of wooden superstructure of bridges is 6,092.5 feet, or 1 mile 812.5 feet and they are in number 48, both exclusive of road bridges over the railroad.

There are on the Albany road 17 wooden railroad bridges, including the 2 of 160 feet at the Greenbush and Albany landings; total length, 1,474 feet; 14 are for a single track only. The whole are built after Howe's plan, and the truss frames are covered in and white-washed.

There are on the Western road 10 stone arched river bridges, severally of spans of 35, 15, 45, 60, 60, 60, 45, 20, 45 and 45 feet, the grades of which, above the water, are severally 40, 12, 35.8, 49, 61.7, 67, 61, 39, 42, 28.8 feet. In addition, there are 2 stone arch bridges over highways, the grade at one of which is 52 feet above the highway, and 2 similar highway bridges over the railroad.

On the Albany road, besides 15 arched culverts of less than 10 feet span, there are two arched bridges from 10 to 20 feet span, two of from 20 to 30 feet span, and one of 34 feet, composed of 2 spans of 15 feet each, and a pier of 4 feet.

At Canaan, on this road, and about 3 miles west of the State line, is a *tunnel*, through limestone and slate rock, the grade in which is 100 feet under the surface at the highest point. It is 548 feet long, exclusive of the thorough rock cuts at each end, 26 feet wide and 19 feet high; the sides and arch being exclusively of the natural rock. It contained 9,920 yards of rock, and its excavation cost about $35,000.

The following is an *approximate* statement of the quantity of materials excavated in the construction of both roads.

	Earth Cubic Yards.	Loose Rock. Cubic Yards.	Solid Rock. Cubic Yards.	Total. Cubic Yards.
Western road,	6,156,117	81,396	543,600	6,781,113
Albany road,	1,553,423	19,177	227,395	1,799,995
Total, yards,	7,709,540	100,573	770,995	8,581,108

The quantity of masonry on the Western road, in perches of 25 cubic feet each, is about 220,586
On the Albany road, 49,968
Total on both roads 270,554

On the Albany road and depots there have been driven 3855 piles.

For the road-way, on both roads, the least *width of land* taken, except for a short distance in the village of Worcester, is 5 rods, and this has been increased, even in one case, to 18½ rods, where required for deep cuts or high embankments, allowing a *berm*, on each side, of 8 feet, for ditches and fences.

The whole quantity of land in the road-way thus located, between Worcester and the line of New York, and for the Western road, as *approximately* estimated, is 1,267 acres 73 rods.
The same for the Albany road is 381 " 78 "
Total, 1,648 " 151 "

With few exceptions, comparatively, the title has been obtained by purchase and deeds, and the claims for lands for road-way are all settled and paid off, with the exception of one on the Western and two on the Albany road, which have been unavoidably delayed, but are in progress. There are, on the Western road, 23 depots, comprising about 54 acres of land; and on the Albany road, 6 depots, containing, at present, 64 acres,—21 of which are at the Greenbush station, making, on both roads, 29 depots, with about 118 acres of land.

FINANCIAL DEPARTMENT.

The accounts for the construction of the Western road, and for the equipment of the whole line, are so far completed as to enable the undersigned to present the following:

Statement of the cost of the Western Railroad, to January 1st, 1843, with an estimate for future expenditures.

ITEMS OF EXPENDITURE.	Amount of estimates of January, 1841.	Amount paid January 1, 1843.	Amount expended or contracted for, and unpaid.	Total paid or contracted for.	Amount estimated for future additions.	Total for ultimate entire cost.
Graduation and road-bed,	2,181,746 67	2,269,983 17	12,394 74	2,282,377 91	7,000 00	2,289,377 91
Masonry exclusive of Connecticut river bridge,	639,301 42	724,158 91	1.633 07	725,791 98	3,000 00	728,791 98
Superstructure,	998,200 33	1,010,628 28		1,010,628 28	5,000 00	1,015,628 28
Connecticut river bridge and masonry of ditto,		131,612 12		131.612 12		131,612 12
Other bridging exclusive of masonry,	213,671 19	108,738 03	1,819 60	110,557 63	7,000 00	117,557 63
Depot buildings, fixtures, aqueducts, etc.	123,250 71	157,431 42	7,929 25	165,360 67	23,300 00	188,660 67
Land damages for road-way,	173,440 31	175,523 33		175,523 33		175,523 33
Depot lands,	10,585 27	16,361 49		16,361 49	5.000 00	21,361 49
Engineer department, instruments, etc.,	167,594 93	190,248 86		190,248 86		190,248 86
Miscellaneous expenses,	67,334 37	74,205 21		74,205 21		74,205 21
Engines and cars,	450,000 00	467,427 04	102,620 00	570,047 04	72,500 00	642,547 04
Interest,	209,900 67	*205,822 43		205,822 43		205,822 43
Extraordinary expenses of renting the Hudson road as a substitute for a part of the Albany road.		33,470 57		33,470 57		33,470 57
Totals,	5,235,025 87	5,565,610 86	126,396 66	5,692,007 52	122,800 00	5,814,807 52
* Interest paid to January 1, 1843,		555,263 13				
Less net income to same date,		349,440 70				
		205,822 43				

The entire cost of the Western road as now stated, exceeds the estimates made therefor by the engineer and agent, in January, 1841, by the sum of $579,781 65.

This excess occurs principally in the items of graduation, masonry, bridging, depot buildings and engines and cars. In the absence of that engineer, the undersigned proceed to state the causes of this excess, as fully as they are able, from the information at their command.

The extra cost of the graduation and masonry is caused by an omission in the estimate of 1841, to include an early payment to a contractor, who had abandoned a section, and a misapprehension of the division engineer, of the contract price of one of the heavy rock

sections,—by extraordinary disbursements authorized by the board in order to open the western part of the road before the winter of 1842—by improvements and alterations made by the road-masters after the road was opened,—properly chargeable to construction,—by the necessity of greatly increased expenses, in raising the original grade in the mountain division, to protect the road-bed against the freshets of an impetuous stream, and by grading and masonry, more recently required by the business of the road for additional depot and turnout tracks, and depot accommodations.

The last cause has also operated to increase the *superstructure* account.

The excess in the cost of *bridging* arises from work not originally contemplated,—such as *tinning* the whole flooring of the Connecticut river bridge,—placing, for greater security, 3000 perch of rubble stone about the piers; and the cost of extra timber for an entire span of that structure, to be housed and kept on hand for future use, in case of any casualty requiring it. And a similar supply of timber for renewing suddenly the superstructure of any other bridge on the road, together with recent expenses of strengthening the bridges between Springfield and Pittsfield. To these is now added a small estimate for future contingencies.

The large excess in the account for depot buildings is almost entirely caused by increased accommodations at the various depots, and by the addition of new ones, shown to be indispensable to the increasing business of the road; and by an estimate for future contingencies of the same character. The principal details of these have been hereinbefore stated.

The same causes have operated to increase the cost of depot lands.

The cause for the great excess of about $192,000 for the items of engines and cars, has been already fully explained.

In connection with this subject, it may not be irrelevant to add, that such was the character of many parts of the line, and particularly of the mountain division, that it was impracticable even for an experienced engineer to estimate before-hand, the cost of construction, with reasonable accuracy.

The 7th or mountain division, of 13.89 miles, has cost $980,000, or over $70,000 per mile. A single mile of that division cost $219,929 87. The summit section in Washington 1.8 miles long, cost about $241,312 39, or per mile, $134,000. It had in it 97,000 cubic yards of rock excavation, much of it very hard.

About 1100 feet of the embankment in the Richmond swamp, settled below the natural surface from 75 to 90 feet, as estimated; and that section alone contained 241,800 cubic yards of excavation, and it cost about $110,000. The single structure of the Connecticut river bridge cost $131,612 12.

The construction accounts of the Albany and West Stockbridge railroad are not so fully closed. The last division of that road was opened, only in September last, and the final measurements and estimates of a part of it, are but just now made out. The contracts for the very extended works at the Greenbush depot, are, some of them, still outstanding. The resident engineer, however, presents the following, as an approximate statement of the cost of this road, with an estimate for future additions and payments.

Statement of the cost of the Albany and West Stockbridge Railroad, to January 1st, 1843, with an estimate for future expenditures.

ITEMS OF EXPENDITURE.	Amount of estimates of January, 1841.	Amount paid January 1, 1843.	Amount expended or contracted for, and unpaid.	Total paid or contracted for.	Amount estimated for future additions.	Total for ultimate entire cost.
Grading, bridging and masonry, including Greenbush depot,	646,099 00	761,381 75	93,400 00	854,781 75	10,000 00	864,781 75
Superstructure,	380,783 00	287,609 21	16,600 00	304,209 21	4,000 00	308,209 21
Depot buildings, fixtures, aqueducts, etc.,	28,511 00	87,158 55	52,500 00	139,658 55	20,500 00	160,158 55
Land damages,	83,985 00	91,180 15	550 00	91,730 15	1,554 77	93,284 92
Depot lands,	41,154 00	30,547 18		30,547 18	9,000 00	39,547 18
Fencing,	36,447 00	25,054 16	7,500 00	32,554 16		32,554 16
Engineering, superintendence, instruments, etc.,	40,825 00	49,721 65	5,000 00	54,721 65		54,721 65
Miscellaneous expenses and contingencies,	20,000 00	17,056 56	9,000 00	26,056 56		26,056 56
Interest,	70,000 00	100,994 81		100,994 81		100,994 81
Part payment to Hudson company for right to build partly on their road-bed,		36,000 00		36,000 00		36,000 00
Payments to original stockholders for their preliminary expenses,		18,136 58		18,136 58		18,136 58
Steam ferry boat and fixtures, etc., for ditto, in Albany.	65,000 00	16,738 68	800 00	17,538 68		17,538 68
Totals,	1,412,804 00	1,521,579 28	185,350 00	1,706,929 28	45,054 77	1,751,984 05
Add the same for the Western road,	5,235,025 87	5,565,610 86	126,396 66	5,692,007 52	122,800 00	5,814,807 52
Totals, both roads,	6,647,829 87	7,087,190 14	311,746 66	7,398,936 80	167,854 77	7,566,791 57

The entire cost of the Albany road, as above stated, exceeds the estimate of January 1841, by $339,180 05; and this excess has arisen *entirely* from payments and expenditures for work not included in the original estimates.

As has been before represented, the whole character of the depot arrangements at Greenbush has been changed by authority of the board; and the whole accommodations, including lands, buildings, fixtures, docks, and bridges, have necessarily been very much enlarged.

In the summer of 1841, while the grading between Greenbush and Chatham was in progress, with a view to its completion early the following summer, the board, having resolved to push the work on the last division of the Western road, so as to open it for use during that year, gave directions also, to expedite this work and lay down the track so as to run the trains through between Worcester and Greenbush, before the winter should close in. This caused a heavy expenditure.

It was found also, in the progress of all the work on the line, through extensive clay and slate rock districts, that the security of the road required much more enlarged excavations and embankments than had been contemplated.

The preceding tables show that for the completion and full equipment of both roads, and for future additions deemed necessary, the expenditure will be $7,566,791 57.

But it should be borne in mind that there are sinking funds, provided for both roads and set apart to aid in the final liquidation of the debts incurred in their construction.

The amount of these on the 1st of January, 1843, was for the

Western road,		$177,529 58
Albany,	about	107,000 00
Total,		$284,529 58

And, although this is not available for present purposes, it is proper to consider it as *assets* of the company, in comparing the value of the work with its cost.

Several errors having crept into the paper on Dr. Earle's process, in our January number, we give it a second insertion, with some additional matter.

To the Editor of the Railroad Journal.

Philadelphia, February 22d, 1843.

Sir,—The following documents and testimonials explain themselves; and it is presumed, cannot be read without producing a strong conviction of the value and importance of the "Process" to which they relate. I beg the favor of an insertion of them in the Railroad Journal, and am, very respectfully, your ob'dt. servant, Edw. Earle.

Ordnance office, Washington, 12th Jan., 1843.

Hon. J. C. Spencer, *Secretary of War.*

Sir,—I have to acknowledge the receipt of a letter from the Hon. R. H. Bayard, of the United States Senate, requesting to be informed of "the result of any experiments that may have been made under the auspices of the Department, in relation to Dr. Edward Earle's method of preserving timber and cordage; together with the opinion of the department, or of any of its officers, as to its practical value,"—the same being referred to this office for a report.

The great cost of gun carriages, and the difficulty of obtaining suitable timber for their construction, induced this office, early in 1840, to consider

whether the interests of the service could not be promoted by the adoption of measures to prevent their decay. "Kyanizing," and "Dr. Earle's process," were both duly considered, and the great expense of the former led to the use of the latter, by authority of the Secretary of War. Since the summer of 1840, about 70,000 cubic feet of timber have been cured at the Watervliet Arsenal, the greater part of which is deposited in store for future use. The exact cost of the operation cannot be stated; but it is believed to be about* cents per cubic foot, and one and a half cents for the use of the patent right.

Sufficient time has not yet elapsed to prove the value of the process by the trials of gun carriages in service; but during the period of operations, the person charged with the supervising the curing of the timber (Mr. R M. Bouton,) has made some experiments, which are set forth in a printed paper published by Dr. Earle, which is hereto appended.

Mr. Bouton is a man possessed of much more science than is usually found in such a first rate practical mechanic, and full reliance may be placed in his statements.

Upon a careful examination, of the subject, which its importance to this office, in a pecuniary view at least, seemed to demand, I have formed the opinion—

1st. That the impregnation of timber with the sulphates of iron and copper may be effected by its immersion in a proper solution of those minerals at a moderate heat, and with timber of any size or length.

2d. That timber, thus cured, will be in a great measure incorruptible, free from the attacks of worms, and from dry rot.

3d. That its strength is not reduced, and its toughness or fibrous texture is improved.

4th. That the cheapness of the process, united to its beneficial effects, promises a great reduction in the expenditures for such objects as are susceptible to its use, among which canvass and cordage seem to occupy a prominent place; and finally,

That this process will furnish the desideratum for the preservation of many things to which it is applicable, and should be patronized by the government.

I have the honor to be, Sir, very respectfully, your ob'dt. serv't.

G. TALCOTT, *Lt. Col. Ordnance.*

(INDORSEMENT BY THE HON. SECRETARY OF THE NAVY.)

Navy Department, Jan. 17th, 1843.

"I unhesitatingly express my full concurrence in the opinion and recommendation of Col. Talcott with [illegible]iven. I have no doubt that Dr. Earle's process might be advantageously applied to a great variety of materials used in the Naval service, and that the saving to the country would be incalculably greater than the cost. I therefore strongly recommend the adoption of Dr. Earle's process upon such terms as may be considered fair and just between him and the country.

"A. P. UPSHUR."

Navy Yard, Washington, 5th Jan., 1843.

SIR,—Agreeably to your order of to-day, I have tested the relative strength of the two pieces of rope received from Dr. Earle, being, according to his representation, different portions of the same rope; one being pre-

* The cost is here omitted because the several items constituting it could not be separately ascertained. According to Mr. Bouton's Report, however, it does not exceed 3 1-3 cents per cubic foot, and this may be confidently affirmed very much to exceed what is necessary, when the operation is advantageously conducted. E. E.

pared, according to his process, with the sulphates of iron and copper, the other unprepared; and find the result to be as follows:

The unprepared piece sustained a weight of only 71 pounds (average,) and the prepared that of 133 pounds; making a difference of 62 pounds in their relative strength.*

Very respectfully, your ob'dt. serv't.
ALFRED TAYLOR, *Lieut.*

CAPT. B. KENNON, *Com'dt.*

Dr. Earle may make any use of this paper he chooses.

B. KENNON, *Captain, Washington Navy Yard.*

Office of the Baltimore and Susquehanna Railroad Company,
February 6th, 1843.

DEAR SIR,—Having been absent from the city, I did not receive your favor of the 3d inst. until Saturday.

It gives me pleasure, now, to state the substance of the reports made to me by the superintendent, and by the machinist of this company; the statements of whom may be relied on with confidence. I only regret that the shortness of the period, during which we have been making use of Dr. Earle's process, does not enable us to speak with as much certainty of its effect in preserving timber as I could desire.

1. We commenced the use of Dr. Earle's plan on the 3d April last.

2. The largest piece of timber to which his process has been applied, was one of yellow pine, 25 feet long and 13 by 10 inches in width and thickness. This was used for a turn-table, and, in framing, it became necessary to notch each piece half way through, near the centre. It appeared to be well saturated with the solution, judging from the deposite of copper on the tools, and from the wetness of the wood, which had been seasoned before being placed in the vat.

About seven months since, the superintendent took two stakes made of a piece of white pine board, one inch thick. One of these he placed in the vat with some timber preparing for the road. They were subsequently both stuck in wet earth. The stake that was *Earlized* is now perfectly sound; the other evidently decaying.

From these circumstances it may, I think, fairly be inferred, that Dr. Earle's process will have a considerable effect in preserving timber from decay; but we have not had sufficient experience to justify us in pronouncing our opinion, as to the extent to which this effect will be produced. We are continuing to subject all the timber used in repairs of our road, to the treatment recommended by him.

With much respect yours, very truly,
CHAS. HOWARD, *Pres't.*

GEN. JNO. S. SMITH, *Washington.*

From the Civil Engineer and Architect's Journal.

CONCRETE, ITS INTRODUCTION, COMPOSITION, USES, & COMPARATIVE EXPENSE.

Concrete was first used in this country by Sir Robert Smirke, at the erection of the Penitentiary at Millbank, afterwards at the undersetting of the walls of the New Custom House, and has been generally used by the above named architect in the public buildings since erected under his care, especially at the club house of the Oxford and Cambridge University in Pall Mall, where the whole area of the building, and to the extent of two feet beyond the line of the lowest footing, was covered to a depth of 2½ feet.

* The strength being tried by applying the strain to each individual yarn.

the depth being increased to 4 feet under all the walls that rise to the roof; in the specification of the last named building it is thus described. "For the grouted stratum clean river gravel is to be provided, and mixed with lime ground or pounded to a fine powder; it is to be well mixed with the gravel, twice turned over before it is wheeled to the excavation, and it is to be thrown from a height of not less than 6 feet in every part. A man to be kept treading down and puddling the mass as it is thrown down; the proportion of materials to be 6 parts of gravel to one of Dorking, Merstham, or Haling stone lime." It has now become, in the present day, the most favorable expedient resorted to for artificial foundations. Mr. Ranger, of Brighton, improved the above hint by using hot water to facilitate the setting, for which he took out a patent for making artificial stone. A detailed account of the application of Mr. Ranger's artificial stone to the building of docks and river walls at Chatham and Woolwich, is given in the first volume of the *Journal*, being a paper by Lieut. Denison, from the Papers of the Corps of Royal Engineers. Analogous to concrete is beton, from which it differs, in broken stone being used instead of gravel, in the proportion of two of stone to one of lime or pozzolana of Itally, a description of which, taken from the *Franklin Journal*, appeared in volume 3, page 265, of your valuable periodical. Since the introduction of concrete, some little difference of opinion as to the proportion of materials and manner of mixing them has arisen among engineers. I therefore give the composition from several specifications: No. 1. The concrete to consist of 5 parts of clean gravel, perfectly freed from loam or clay, with a proper proportion of small gravel and sand, as well as large, and one part of lime measured dry, the lime to be mixed into a perfectly smooth uniform paste, as for the mortar, but with more water, and then thoroughly mixed with gravel. No. 2. The concrete to be composed of sandy gravel and well burnt lime, in the proportion of 3 of the former to 1 of the latter. The gravel to be free from all earthy matter, and the pebbles not to exceed one inch in diameter. The lime is to be used in a hot state when slacked, and to be immediately mixed, using no more water than is sufficient to incorporate them. After being twice turned, it is to be wheeled on to a stage 10 feet high, and let fall into the trench; it is not to be puddled or disturbed in any way until perfectly set. No. 3. All concrete must be composed of gravel perfectly clean, and mixed with fresh well burnt lime in the proportion of 6 of gravel to 1 of lime. The lime and gravel to be mixed in a dry state, and a sufficient quantity of water afterwards added. No. 4. Concrete to be composed of good lime, gravel, and sand, in the proportion of $\frac{1}{7}$ to $\frac{1}{9}$ of lime, and it should be laid in about 12 inch layers or courses, and pitched from a height of 10 to 12 feet, neither should it be disturbed until properly concreted and set.

In the above five opinions, including that of Sir Robert Smirke, we have the relative proportions of gravel and lime, varying from 3 to 9; and No. 1 states the lime and water to be first mixed, in which No. 2 nearly coincides, while No. 3 insists on the gravel and lime being first mixed, and then the water added; Nos. 4 and 2 coincide that the concrete is not to be disturbed after it is thrown into the trench, while Sir Robert Smirke expressly states that parties are to be employed puddling the mass. The whole are agreed in specifying that the material is to be thrown from a height. From considerable practice and experience in the mixing of concrete, I think that the lime need not be ground, but simply mixed with the gravel, and then, by the addition of water, it will fall to an impalpable powder, also that it is unnecessary to be at the expense of puddling the mass after being deposited in the trenches, neither is there any advantage to be derived from discharging the

mixture from a height, both of which operations increase the expense of the concrete, and as the concrete in the act of setting expands in bulk, I think that alone a sufficient proof of the inutility of both of the above mentioned operations, their tendency being to condense the mass, while its own natural tendency is to expand. With respect to the proportion of lime and gravel, I think the less lime the better will be the concrete, and that the proportion of 8 to 1 of lime is decidedly better than 3 of gravel to 1 of lime. As to the quality of materials employed, the lime must be stone lime, fresh from the kiln; that from chalk will not do, and hydraulic or lias lime is to be preferred to stone limes. With respect to gravel, if obtained from a pit, the ochereous or ferruginous is to be preferred, and if loam is present, so as to soil the hand, the gravel must be washed, if the gravel be obtained from rivers by dredging, alluvial and vegetable deposits are to be avoided; and if the gravel contain vegetable refuse, it must be screened or washed. Shelly sharp gravel is the best; the proportion of small or large pebbles, and the due quantity of sand, is soon learned with a little practice.

As to the uses of concrete, it is principally adopted as an artificial foundation, and from four to six feet is a sufficient depth, and extending two feet beyond the space to be occupied with the building. The following testimony of the utility of concrete, is from Weale's bridges, page 31. "Piling will probably never be found more safe than a body of concrete; the latter cannot be too much esteemed, for its durable and almost imperishable nature, besides being quite as safe and, perhaps, more durable than piling;" and from the paper of Lieut. Denison, before alluded to, we have the following ratification of its uses. "Concrete cannot be advantageously employed as a building material." "It may be employed with advantage in backing retaining walls." I. K. Brunel, Esq., C. E., has used concrete as a foundation, nearly exclusively and universally in the bridges on the Great Western railway; and in the celebrated bridge of Maidenhead, the land arches are backed with concrete. In culverts underneath embankments, the same able engineer has extensively used concrete as a backing material, the brickwork being kept thin, and then enveloped in a mass of concrete, in the form of a polygon, of six sides, or, of the form of two truncated cones, with their bases joined.

Concrete was used on the Great Western railway, wherever it could be employed, as a backing material; its use is now rapidly extending to the provinces, and bids fair to supersede all other means now employed for making a foundation; it is much improved by being mixed with oxide of iron, smith's scales, and roasted iron stone, or any material containing iron. As regards the comparative expense, brickwork being the most common building material, has been taken as the standard of comparison with concrete for price, and its cost in most districts will be found from one-third to one-sixth the price of brickwork, taking a cubic yard as the quantity of each material, the latter will cost 5*s.* and the former 21*s.* both, to a great extent, being regulated by the vicinity of brickyards, and the facility of obtaining gravel. I have known concrete executed at 3*s.* 3*d.*, 3*s.* 6*d.*, 4*s.*, 4*s.* 6*d.*, 5*s.*, 7*s.* 6*d.*, 8*s.* 6*d.*, and 11*s.* 6*d.* per cubic yard, although the most common price is 7*s.* 6*d.*; as to brickwork, the general price is 21*s.*, and the range is from 14*s.* to 27*s.* 6*d.* per cubic yard. The London price being 25*s.* per cent. dearer than the country. The facility of obtaining lime regulates the cost of concrete; the price of lime per cubic yard, measured dry in clots, at Dorking in Surrey, is 11*s.*; Barrow in Leicestershire 21*s.*; Bulwell in Nottinghamshire 9*s.* 6*d.*; Breadon in Derbyshire 15*s.* 6*d.*; Harefield in Buckinghamshire 16*s.* 6*d.*; Fulwell, Durham county, 9*s.* The measures of

lime, also, vary much; in some places it is sold by the cubic yard, measured dry, which is decidedly the best method adopted; it would be desirable if it was universal. It used to be sold in London by the hundred, as it was called, not of weight, but a measure, a yard square, and a yard and one inch deep, which will be equal to 16 or 18 bushels, but it is now sold by the cubic yard. The Fulwell and Barrow lime is sold by the quarter, eight of which make a ton and a half. Lime is also sold by the boll and chaldron; a chaldron will be about 3½ tons, a single horse cart about 6 bolls. In agricultural districts, the bushel, boll and quarter are used; in colliery districts, the chaldron and ton are the standard of measure. With respect to the cost of gravel, provided it can be obtained on ground belonging to the company, the getting, screening, and cartage will cost 1*s.* 6*d.* to 2*s.* per cubic yard; if it be obtained from the gravel pits of the country, the charge will be per ton, from 2*s.* 6*d.* to 2*s.* 9*d.*, if screened 3*s.* 3*d.* to 3*s.* 10*d.*, if broken 6*s.* 10*d.* A cubic yard will weigh from 24 to 27 cwt. If the gravel is dredged or brought from the shores of a river, the cost will be 2*s.* 6*d.* per yard, or nearly the same as from the pit. The prices of the various operations of getting, screening, and washing gravel are respectively 10*d.* and 12*d.* per cubic yard. The price of excavation is also included in the price of concrete in all railway specifications, which will be about 4*d.* per cubic yard, as generally the excavation is of limited extent, and consequently more expensive than an extensive excavation, and when the gravel is obtained on the ground of the company or proprietor, the excavation is a double operation, the hole having to be refilled with other materials in lieu of the gravel obtained. From the experience of several thousands of yards and variety of situations, I find the cost of mixing the materials, or as it is termed concreting, to be 1*s.* per cubic yard, and taking the proportion of material at 5 to 1, the following will be a fair estimate of the cost of concrete:—

	s.	*d.*
1 cubic yard of lime,	12	6
5 do. of gravel at 2*s.* 6*d.*,	12	6
Labor mixing at 1*s.* per yard,	6	0
6 yards of excavation at 4*d.*,	2	0
Waste, contingencies and profit, at 1*s.*,	6	0
6 cubic yards, at 6*s.* 6*d.*, =	39	0

Concrete will set in 24 hours; the specific gravity is 125, or about the same as brickwork, although brickwork is sometimes 165 lb. per cubic foot. Lieutenant Denison gives the strength of concrete $S = \frac{l W}{4bd^2}$. The constant S being 9·5, and comparing concrete to York paving, the proportion is as 1 to 13.

The following works may be consulted; Colonel Pasley, on Calcareous Cement: Weale, 1839; Aikin, on do., in Transactions of Society of Arts; Lieutenant Denison's Notes on Concrete, from papers of Corps of Royal engineers, *Journal*, volume 1, p. 380; Lieutenant Colonel Ried, ditto, see also, the *Journal*, volume 1, p. 134; a letter on concrete, by a Constant Reader, volume 3, p. 265, volume 5, p. 58, 276.

I am, etc., O. T.

St. Ann's, Newcastle-upon-Tyne.

For the Railroad Journal and Mechanics' Magazine.

PRODUCE AND MERCHANDIZE DIVERTED TO BOSTON BY "LOW FARES."

By an official report to the legislature of Massachusetts under oath, we derive some facts that may be interesting to us.

It appears that the whole number of way and through passengers, passing over the Albany and West Stockbridge railroad and Western railroad, 156 miles, to the Boston and Worcester railroad, was 190,436.

The number of miles run by the merchandize cars, was			160,089
Equal to single trips, *through* 156 miles,			1,026
The weight of the merchandize carried over the road, was equal to 6,211,971 tons *nett*, transported one mile only. Or, equal to,			
carried over the whole road, 156 miles,	tons,		39,820
This, for 1026 trips, gives per trip,	"		38¾

The average tonnage per trip is very much below the ordinary capacity of the freight engines, and much below what would be desirable for a profitable freighting business.

The report then goes on to state:—"as a striking evidence of the excess of business turned East, it may be stated, in reference to the business of the Greenbush station, opposite Albany, that during the last year there were

sent from that place eastward 170,715 bbls. flour,	tons,	18,615	
And other merchandize,	"	12,374	—30,715
The amount received at Greenbush from the East, for the last year, was	"		5,624
Difference,	"		25,091
The amount *through* from Albany to Boston, was	"	14,128	
Amount through from Boston to Albany,	"	2,472	
Difference,			11,656

The directors make the remark:—"It ought to be borne in mind, that, at the commencement of the year, the road had but been partially opened to the Hudson river, giving an access to a community, before that time, almost secluded from an eastern market. The business sought for, had long been accustomed to other and desirable channels of communication, and to other and *larger markets.* The last year has been therefore, emphatically one of experiment,—a year for ascertaining the difficulties of the trade in which we have embarked, and for gaining a knowledge of the means by which the difficulties might be obviated for the future. We virtually had no experience to guide us, in fixing upon tariffs of charges, *that would command the traffic, etc.* Notwithstanding these embarrassments, the undersigned look upon the past year as one of signal success."

Let us regard the subject in view of the low rate of 32 cents for a barrel of flour from Albany to Boston.

They took over their road 170,615 barrels, or	tons,	18,341	
There was taken from Albany in merchandize, beef, pork, etc.	"	12,374	—30,688
The whole tonnage carried over the road,			39,820
Difference, all the business of New England,	"		9,132

It would appear that three-fourths of the freight business over the Western railroad, was from the mouth of the Erie canal, while 16,560 tons, (principally flour,) was distributed on the line of the road. There were about 240,000 bbls. of western flour sent by schooners, and through New York to Boston. A reduction of fare to 25 cents per bbl., as contemplated, will command this freight, while they can afford to take sugar, molasses, and bulky articles, by the return trains, *at half the rates* we now charge by our tow boats on the North river. We argue this to be the case, as we perceive the *through* freight going east, is 30,688 tons,—compared with 5624 tons transported west. That they will profit by the "last year's experience," and "*so regulate their charges as to command the traffic,*" to a considerable ex-

tent, there can be no question. They have $7,050,000 embarked in the Western railroad to Albany. Boston owns half the railroad stock on the line from Albany to Buffalo. She has, with the citizens of New York, $30,000,000 of capital advantageously invested in railways, yielding a nett profit exceeding 6 per cent. per annum. The capitalists of the city of New York have expended about $10,000,000 in the way of improvements, and cannot put their finger on a single railroad enterprize that yields her a dividend. They have all been ill judged, while she leaves the line to Albany, through a fertile and rich country, to linger, when it has been repeatedly demonstrated, by repeated examinations, and estimates uncontradicted, that this road will pay a better income than any railroad in the United States.

J. E. B.

CIRCULAR

From the committee appointed by the National Institute for the promotion of Science, in June, 1842, consisting of—

Hon. JOHN. C. SPENCER, Secretary of War, chairman.
Hon. LEWIS F. LINN. U. S. Senator, Missouri.
Hon. WM. C. PRESTON, U. S. Senator, South Carolina.
Hon. JOS. R. INGERSOLL, House of Representatives, Philadelphia, Pa.
Hon. ABBOTT LAWRENCE, Boston Mass.

WASHINGTON, February 24, 1843.

To the friends and correspondents of the National Institute and the members of scientific and learned societies of the United States, etc., etc.

On the 15th of October last a circular was addressed to the scientific and literary men of the United States, transmitting a copy of certain proceedings of the National Institute for the promotion of science, and inviting particular attention to that portion of the proceedings which contemplated the general meeting proposed by the Institute to be held at the seat of government.

The circular was at first attempted to be sent directly to individuals, but it was soon found impracticable to address all who were entitled to special invitation. The members of the institute, and those who had, in various ways most liberally contributed to the promotion of its objects, were of course expected to attend; yet the difficulty of obtaining all the names and residences of others, eminent in the various branches of knowledge, rendered it necessary to resort to a more general mode of effecting the purpose. With this view the circular was published in the papers of the District of Columbia, and was thus made general.

The object of the first circular was not to fix any particular time for the meeting, nor was it intended by the Institute or the committee to make Washington the place of all subsequent meetings, if it should appear to be contrary to the judgement of those who had the right to decide upon such an important question. It was rather to obtain preliminary views of the friends of the Institute, and general information as to the time and mode of convening; and afterwards to adopt a plan and a time (which might be gathered from the replies of those whose opinions had been solicited) to be the most convenient.

These replies have been numerous and interesting, and present almost without exception a decided approbation of the step that has been recommended, as well as of the course of the Institute under the auspices of which that step has been begun. The committee, after having carefully considered these replies, have come to the conclusion that the month of April, 1844, is the period which will best suit the convenience of all.

The committee were aware that several previous attempts had been made to get up a similar meeting upon the plan of the British Association, and that those attempts had proved fruitless. Perhaps too much was expected at a time when our learned men were unprepared for co-operation in such extended plans. But the idea had found favor, and it may be affirmed justly that we owe, in no small degree, to the system of State geological surveys the present improved prospect of accomplishing a noble and long-cherished object.

Under these circumstances, about three years ago, some of the gentlemen engaged in the New York survey (the fruits of which are already beginning to appear in published volumes, reflecting honor upon the liberality of the State and credit upon the abilities of those who have been engaged in the enterprise) proposed to bring about the object by a different method. Circulars were sent by them to geologists of other State surveys, and a meeting was held in Philadelphia in 1840. This meeting was respectable, and resulted in the formation of the "Association of American Geologists." It adjourned and met again in Philadelphia in 1841. At the second meeting it was deemed expedient to adopt the foreign plan of changing the place of meeting. Boston was chosen as the place for the third meeting, at which its objects were extended, and the association became the "Association of American Geologists and Naturalists." The fourth meeting is to be held in Albany during the month of April, 1843.

The proceedings of this association had been witnessed by the National Institute with feelings of deep interest; and in 1841 a formal invitation was sent from the latter to the former, requesting them to make Washington the place of one of the annual meetings. The invitation was promptly accepted, and it has been decided that the fifth meeting of the "Association of American Geologists and Naturalists" is to be held in Washington in the month of April, 1844.

The disadvantages and inconvenience of two meetings have, after mature reflection, appeared to the committee so obvious, that they have thought it best to fix the first Monday of April, 1844, as the period for the general meeting; and they take this occasion and mode of respectfully inviting to Washington, in the name of the National Institute, the members of the American Philosophical Society, the oldest scientific institution of our country, the members of the Association of American Geologists and Naturalists, and the members of all other scientific and learned societies in the United States, the honorary and corresponding members and friends and patrons of the Institute, and all others engaged and concerned in the "increase and diffusion of knowledge among men."

The plan of operations will be left entirely to those who may be present on the occasion; the Institute and the committee, without attempting to control them in any manner, charge themselves with the duties of making every preparation in their power, adapted to facilitate the scientific objects the promotion of which such a body may be supposed to cherish.

The following report of a minority of the committee on Internal Improvement of the North Carolina legislature contains an excellent answer to some widely current and fallacious opinions in regard to railroads etc. The report of the majority is embodied in the one now published, and we therefore give only the latter. It also contains useful information upon the public works of North Carolina, and will well repay the perusal.

EXTRACTS FROM THE REPORT OF THE MINORITY OF THE COMMITTEE ON INTERNAL IMPROVEMENTS, SUBMITTED TO THE LEGISLATURE OF NORTH CAROLINA.

The minority of the committee on Internal Improvement, have read, with regret, the report of the majority of the committee, on so much of the Governor's message as relates to the subject of internal improvement. The scope and tendency of the report, if not so designed, is to render odious, the message in relation to this subject, to draw into discredit and disrepute the works of internal improvement already established in the State, and to prejudice the public mind against all and every improvement, which may be now contemplated or hereafter devised. To accomplish this purpose, the majority report from carelessness or inadvertence, has assumed facts and hazarded assertions, many of which are altogether groundless, and utterly unauthorized as the minority will now attempt to demonstrate. The report commences with a concise review of the various recommendations in relation to Internal Improvement, contained in the Governor's message, and then proceeds with the following assertion: "The legislature has from time to time granted away to associated wealth, in the shape of corporations, the rivers of North Carolina, and now the people cannot carry a boat load to market, without paying tribute money to navigation corporations." Is this true? The slightest inquiry or the least investigation would have satisfied the majority, that this assertion is entirely without foundation. The principal rivers of the State, are the Roanoke, Chowan, Cape Fear, Neuse, Pasquotank, Tar, Cashie and Trent, on not one of which except Cape Fear, is a cent of toll levied, or authorized to be levied on the transportation of produce below the Falls thereof and but one of them above the Falls, to wit, the Roanoke, where the navigation has been opened and improved at an expense of four hundred thousand dollars by a joint stock company, created by acts of the general assemblies of North Carolina and Virginia. The report of the majority proceeds and asserts, that "the legislature has, from time to time, granted in like manner, exclusive privileges to railroad companies, until they have been stimulated to begin such enterprises; and after exhausting their own means, these railroad companies have procured the credit of the State, and finally involved the people in a debt of more than a million of dollars; though, in the outset, the capitalists who asked for the charters professed to ask nothing but the right of spending their own money for these works. Had they proved profitable, the people at large would enjoy no right but the benefit of paying tribute to these corporations, for carrying them or their produce from home to a market; but, so soon as they proved to be a losing concern, by little and little, the loss must probably fall upon the State treasury. The State had little or no chance of the profit, yet the State is to bear the loss." A more uncandid, disingenuous and incorrect paragraph, has been rarely, if ever witnessed in any paper whatever, and more especially, one emanating from an important committee, appointed to consider subjects deeply interesting to the people of the State. The first assertion in the paragraph, is "that the legislature has from time to time granted in like manner, exclusive privileges to railroad companies." Has any exclusive privilege been granted to railroad companies as asserted, or has any individual, or set of individuals, by the acts of assembly incorporating such companies, been deprived of any privilege previously enjoyed? None whatever. The leading privilege granted to these companies, is to transport on their roads persons and produce at a moderate rate of compensation, and for this purpose, to become common carriers in their corporate capacity. Is any individual, or set of individuals, who may choose to associate together, prohibited from carrying persons and produce whithersoever he or they may please? Are

not persons daily and hourly thus employed in every direction and in every part of the State? No one is bound or obliged to use railroads or avail himself of their advantages, unless at his will and pleasure free and untrammelled. The former mode of transportation of persons and products by stages and wagons or private conveyance, is left free and unincumbered, and none need resort to railroads unless they find their interest promoted by doing so Certain it is, that unless this mode of transportation by railroads is cheaper and better than the former method, they will not be employed, and that they are so employed, affords the most conclusive and satisfactory evidence of the great benefits and advantages resulting from this mode of conveyance. The report of the majority proceeds: "And after exhausting their own means, these railroad companies have procured the credit of the State, and finally involved the people in a debt of more than a million of dollars; though, in the outset, the capitalists who asked for the charter, professed to ask nothing but the right of spending their own money for these works." The fact is notorious, and it ought to have been, if it is not, within the knowledge of the majority, that the people at present are not involved in a debt of more than one million of dollars for the railroad companies, or indeed, for any other sum.

It is true, the Wilmington and Raleigh railroad company, have obtained the credit of the State as security, for two hundred and fifty thousand dollars for which liability, the State has the most abundant and ample security. To secure the State against loss, a mortgage has been executed, under authority of law, on the railroad, the construction of which cost between one million five hundred thousand and two millions of dollars, and whose annual income under the present disastrous and discouraging state of things, after paying all the ordinary expenses of the road, amounts to about sixty thousand dollars. Nor is this all. The mortgage also includes all the property of the company, consisting of steamboats, engines, cars, coaches, lots, wharves, warehouses and depots, worth at a low estimate, independent of the railroad, at least fifty per cent. more than, and perhaps double the amount for which the State is security. It is then absolutely certain, that the State can sustain no loss on this account, unless through the most unwise and blundering legislation. Let us now see how the matter stands in relation to the State liability for the Raleigh and Gaston railroad company.

Under an act of the general assembly passed at the session of 1838, the public treasurer was authorized in his official character, to endorse the bonds of the Raleigh and Gaston railroad company, to the amount of five hundred thousand dollars, by which the State became security for that sum. To secure the State against loss, a mortgage was made by the company, which cost more than a million and a half of dollars, and this was considered at the time, and is now deemed to be ample indemnity. But the State has other and additional security. At the session of 1840, the legislature agreed that the bonds of the company should be endorsed by the public treasurer for the further sum of three hundred thousand dollars, provided the stockholders of the company would give their individual bonds, with good security, to secure the State against loss for the five hundred thousand dollars endorsed by the State in 1838 as before related, and another mortgage on their railroad and all the other property of the company; which condition has been strictly complied with, as we are informed by the governor in his annual message to the general assembly. It will thus be seen, that although the State is security for the Raleigh and Gaston railroad company, for the sum of eight hundred thousand dollars, yet, to indemnify and save harmless the State, a mortgage has been executed for the whole of the railroad and

other property of the company, which cost about double this sum, and the State has the further security of the bonds of individuals with good security for five hundred thousand dollars. With what justice and propriety can it, then, be asserted that the people are involved in a debt for the railroads, amounting to more than one million of dollars? In reference to so much of the majority report as declares that when the stockholders of the railroad companies asked for the charters, they professed to ask for nothing but the right of spending their own money for these works, there is surely some misapprehension, at least in relation to the stockholders in the Wilmington and Raleigh railroad company; for although no aid was granted by the State to effect the work at the time the first charter was granted, the stockholders always looked to the State for assistance, by way of subscription to the stock of the company, which was obtained at the session of 1836. Again says the majority report: "Had they (the railroads,) proved profitable, the people at large would enjoy no right but the benefit of paying tribute to these corporations, for carrying them or their produce from home to a market; but as soon as they proved to be a losing concern, by little and little, the loss must probably fall upon the State treasury. The State had little or no chance of the profit, as long as there was any hope of profit, yet the State is to bear the loss." This is another glaring example of disingenuousness, for which the majority report is particularly remarkable. If the State contributes nothing towards the construction of railroads, and those works are effected at the expense of individuals, what other benefit can the people or State who contribute nothing to the works, expect to derive from them, other than to have their persons and produce transported to market at a moderate rate? He that sows not, neither shall he reap. And upon what principle of equity or justice, can those, who stand aloof and husband their resources, unwilling to aid in accomplishing a great public work of acknowledged utility expect to derive profit from the same in the shape of annual income?

In proportion to the interest which the State has taken in the railroads, (and only in one of them has she any direct interest,) she enjoys an equal chance of profit, in proportion to her subscription, as other stockholders—and more than this she cannot expect. In regard to the other railroad—if the work had turned out to be a profitable investment, the State having subscribed nothing to construct the road, could rightfully expect no profit, except the general benefits and advantages resulting from cheaper and more expeditious transportation to market. Whether the loss of making the railroads in this State is likely to fall upon the State treasury, has been already abundantly disproved. The majority report further sets forth, that "your committee have good reason to apprehend that the same beginning of turnpikes, by corporation charters, will terminate in a similar way to North Carolina. Indeed, your committee greatly misapprehend the message referred to them, if it does not shadow forth this very unusual second step in their charters, when it is recommended to give these turnpikes such aid, etc., as the condition of the public treasury may justify." Suppose, for the sake of argument, it should turn out that the money expended for the construction of the railroads in this State is a bad investment of capital, which the minority of the committee hope presently to prove is directly otherwise, does it necessarily follow, that turnpike roads, the utility and advantages of which have been tested and experienced by every State in the Union, north of this State, nor any other project of internal improvement, is ever to be again attempted within our borders? Hopeless, indeed, would be the condition of our Western brethren, who are, unquestionably, as much entitled to the fostering care of the legislature as any other portion of the people in the State.

if this is to be the fixed and settled policy for our future government. It is a policy, wholly and absolutely opposed to the enlightened age in which we live—the present advancement in civilization and improvement of the civilized world—and utterly inconsistent with the prosperity and happiness of the people of the State. If the principles of the majority report are to govern the future policy and destiny of the State, most degraded and miserable will be the condition of her people, in comparison with those of other States. With resources uncrippled, and an energy unsubdued, North Carolina will, in a few years, become the byeword of reproach and contumely throughout the length and breadth of our extended country. But a few years ago, and there was scarcely an enlightened and liberal man in the State who was opposed to a judicious system of internal improvement. What great and monstrous error has been committed on this subject within this State? What foolish, wasteful, and extravagant expenditure of public money has occurred to reduce and lower the tone of public sentiment in relation to internal improvement? The minority of the committee know of none whatever; and if the public feeling has undergone any material change on this subject, it must be referred to other and different causes. It is the misfortune of the age in which we live, that every thing, however useful and valuable, no way connected with federal politics, must be mixed up with the wretched party squabbles of the day, and nothing, however important to the welfare of the State, is allowed to escape this miserable contamination. And, in this regard, it is a melancholly reflection, that we are daily growing worse and worse. It was not the case a few short years ago, and the people must rouse up and cast off the fatal error, or there is too much cause to apprehend the most disastrous results. The necessity of judicious works of internal improvement has been long felt and acknowledged by the most enlightened and patriotic men of both the political parties which now divide the State. They have seen and felt this great necessity, and have, from time to time, urged upon the general assembly the adoption of needful measures to improve the condition of the State. If there be any thing erroneous or wrongful in this it is a wrong or an error common to both parties, and for which neither is alone responsible.

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The larger portion of the remainder of the majority report is devoted to building up a man of straw of their own creation, that they might have an opportunity of exhibiting their skill and dexterity in toppling it to the ground. Thus the majority assert, "that the treasury is in no condition to aid in the construction of turnpike roads, and that it is useless to investigate the value and cost of turnpikes across more than half the State, when it is known the State has no funds that can be applied in aid of their construction." "And furthermore, that the legislature ought not to tax the people, or borrow money for this purpose, if they could." Now all this flourish about taxing the people and borrowing money is entirely gratuitous. The message of the governor, contains no such recommendation, but on the contrary, it expressly advises the general assembly, "that whatever schemes of expenditure you may embark in, that you keep within the means at the command of the State; otherwise, the people must be taxed more heavily, or the State must contract a loan. The pressure of the times forbids the former; the tarnished honor of some of the States, should make us for the present, decline the latter." Although he has recommended that certain companies be incorporated to make turnpike roads, which are greatly needed to the west, and would most essentially promote the public welfare; yet the assistance, which he suggests may be given to such improvements at present, should be con-

fined to the means already set apart for internal improvement, and which under existing laws can be applied to no other object. These means consist of a cash balance on hand, and some bonds, which the majority states to amount to forty thousand dollars, and bonds given for the purchase of Cherokee lands, amounting to something less than three hundred thousand dollars; making the aggregate sum of about three hundred and forty thousand dollars. This fund, sooner or later, or a considerable portion of it, must be applied to the making of a turnpike road or roads to the west in aid of individual means and exertions, in some just proportion, perhaps on the two-fifths principle, or some other just ratio, between the State and individuals. A portion of these bonds applied towards the construction of turnpike roads in the western part of the State, when united with individual capital, would, like heaven-born charity, bless both giver and receiver. It would enable the obligees to these bonds, who gave more than double the value of the lands they purchased, to redeem them by the contribution of labor to make the roads, and at the same time, afford a fair return of profit in the shape of tolls on the investment. No time whatever, could be more propitious than the present to engage in such works, but for the fact, that in the present general distress and embarrassment, individuals could not now raise their portion of the means necessary to accomplish this desirable improvement; and therefore, for a time it must be postponed. The expenditure of two or three hundred thousand dollars in the Western portion of the State in the way suggested, where there is now existing an unexampled scarcity of money, would produce benefits, and be attended with advantageous results, which can hardly be described. But the minority have not time to enlarge upon them and must hasten to a conclusion.

It has been a matter of much mortification and surprise, to witness the senseless and inconsiderate clamor which has been raised against railroads, in almost every part of the State. They have been denounced as only calculated to benefit the rich, at the expense of the poor; that their construction has occasioned a heavy loss to the State, without any adequate return; and that, consequently, they deserve not the fostering care of the public. These charges and denunciations have been made and believed for the want of better information, and the minority will now undertake to disabuse the public mind from the deceptions and impositions under which it has labored. The first striking advantage resulting from railroads, is seen in the certainty and despatch with which persons and produce are conveyed on them. Persons travel on them at the rate of one hundred and fifty to two hundred miles in twelve hours, with as much safety as by any other mode of conveyance, and at a great saving of time and expense. The transportation of produce on them, although not quite so expeditious as the conveyance of persons, is yet five times more so than by wagons. This speedy transportation, always advantageous, is frequently of the utmost importance. A rise in the price of produce often takes place, which continues but for a short time, and it is very material that farmers and merchants should be in a situation to avail themselves of such a rise. A single example will sufficiently illustrate this advantage. During the last fall, the price of wheat in Petersburg opened at $1 12½ per bushel. In these times of low rates for all articles, this price was considered very good, and every one felt desirous of profiting by it, for it was forseen that it could continue but for a few weeks. A farmer and merchant in Granville, promptly availed himself of the railroad in his neighborhood, hastened his wheat to market, and obtained for it the price before mentioned; whereas, those who had to depend on the more tardy transportation by wagons, generally sold at but 75 cents per bushel. But a still more striking

and conclusive advantage, results from the great reduction effected in the expense of carrying produce to market. Previous to the construction of railroads in the neighborhood of the falls of Roanoke river, the price of wagoning cotton and other articles to Petersburg, was from 75 cents to $1 per hundred. The price now by railroads, is 25 cents per hundred, so that the saving to the grower of produce is, at the lowest estimate, twice as much as the freight per hundred on the railroad. Again, a merchant of much intelligence, in Raleigh, has furnished the minority with a statement, showing the rates formerly paid on the transportation of produce by wagons, to Petersburg, and the rates now paid by the railroad. From this statement it appears, that the price by wagons was from one to two dollars per hundred, the average being one dollar and fifty cents. The price now paid by the railroad for the same articles, is seventy cents, being a saving of more than one half of the former rate. By wagons, the price paid on salt was two dollars per sack; the price now paid by the railroad on the same article, is sixty-five cents, being a saving of double the amount now paid, by the railroad. The saving to the growers of produce, who send to market by the Wilmington and Raleigh railroad, has also been very great. These facts furnish some data on which to estimate the amount of saving to the agricultural interest in this State.

During the last year, the receipts on the Raleigh and Gaston railroad, amounted to, in round numbers,	$66,000	
Deduct one half of this sum, supposed to have been paid by passengers,	33,000	
And there will be left for freights on produce,		33,000
The receipts on the Wilmington and Raleigh railroad for the same time, amounted to,	230,000	
Allow one fifth part to have been received for freights on produce, is		46,000
The receipts on the Petersburg railroad, for the same period, were	174,000	
Supposing the receipts on produce on this road, sent from North Carolina, not included in the amount sent to that road from the Raleigh and Gaston road, to have been equal to one fourth of the whole receipts, and we have the sum of,		43,500
The receipts on the Portsmouth and Roanoke railroad, for the same time, were	70,000	
The portion collected for freights on produce from North Carolina, is estimated at one-fourth part, and will give the sum of,		17,500
The amount of freight then paid on produce from North Carolina, and supplies received in return, will be		140,000

The saving to the people by the cheaper transportation on railroads, is, as already shown, double the amount of freights, and the consequent saving per annum is two hundred and forty thousand dollars, and in two years and a half, is equal to the full subscription of six hundred thousand dollars, made by the State of North Carolina to the Wilmington and Raleigh railroad company. The minority of the committee cannot, nor do they venture to give the assurance, that the foregoing estimates are correct in all their parts; some may be too high, and others too low, but they have endeavored to approximate as near to accuracy as the information accessible to them allowed. Supposing, however, that the saving to the people by railroads should be

only one half the sum estimated, how much cause has the State, and those persons equally benefitted with stockholders, who have not shared in the heat and burden of the day, to be thankful for this great benefit, and how utterly groundless must be the vituperation and abuse which have been so lavishly heaped on railroads. So far from there being any just cause for this abuse, it is a fact undeniable by any candid man, that the people owe a debt of lasting gratitude to those spirited and enterprising citizens, who have effected such valuable improvements, in which rich and poor, according to the amount of their productions equally participate.

There is another important view of this subject, which seems to have been entirely overlooked or neglected. Even admitting that there may be no return of profit in the form of dividends on the capital invested in railroads, for some time to come, still this capital has not been lost to the State. Much the greater portion of it has been diffused and distributed more equally among the people, and has gone into the pockets of those who have furnished supplies of provisions, materials, and labor, for constructing the roads and still remains in the State, to benefit and bless hundreds and thousands.

The last part of the majority report remaining to be noticed, concerns so much of the governor's message as relates to an application to the general government to open a direct ship navigation between Albemarle sound and the ocean. If the recommendation contained in this part of the message should be adopted, the majority report seems to consider that the general assembly would place the State in the humble and degrading attitude of *begging* the general government for what it has not to give. Nothing can be more erroneous and unjust than this view of the subject. North Carolina asks nothing of the general government, but what she is authorized to demand as a matter of right. Thousands, hundreds of thousands, and millions of dollars, have been appropriated and expended in other States of the Union for similar objects, a large portion of which have, by no means, superior claims to the works proposed to be erected in this State. The State of North Carolina fully shares with her sister States in the burthens of the general government, and why should she not also participate equally with others in its benefits? But this subject has been so satisfactorily examined in a short report, by a member of the minority, whose constituents are more immediately interested, hereto annexed, that nothing further will now be added by the minority.

A. Joyner,
Jon. H. Jacocks,
Alfred Dockery.

AMERICAN MECHANICAL SKILL.

We find in the report of the Judges of the Twelfth Annual Exhibition of the Franklin Institute, several notices of mechanical skill, which are highly creditable to the exhibitors. From all the rest we have selected three which appeared most interesting.

The first is in reference to a theodolite constructed with a view to obviate by a simple contrivance, a disadvantage frequently noticed in the construction of the vernier—its success, however, we doubt, as the risk of inaccuracy appears to be considerable.

The clock spoken of, was presented at the American Institute fair in this city, and to us appeared one of the most original and ingenious contrivances in the whole exhibition. The award of the committee in this case was well bestowed.

The transit, by Mr. Wm. J. Young, also deserves notice as being new evidence of the competency of intelligent American mechanics to compete with the best workmanship, the world can produce.

No. 224, theodolite, made by Edmund Draper. This useful instrument presents a specimen of excellent work, and is of the most approved construction. The verniers are supported on a hinge, so as to rest on the graduated limb with little force, and to move over it with little friction, and thus to prevent the abrasion which is often observed.

No. 356, clock of a new construction, by A. D. Crane. The regulating power of this curious clock is neither a pendulum, nor a balance; but a globe of brass is hung to the end of a long flat steel wire, which, being twisted round in one direction, is untwisted by the weight of the globe and its own elasticity, and wound round in the opposite direction, and so on alternately. At each of these movements, an appendage at the upper end of the wire acts upon an escapement of a peculiar construction, so arranged as to be nearly frictionless, but of which it would be difficult to give an intelligible description in this report. Although this revolving pendulum is no longer than that of an ordinary mantel clock, each revolution of the globe occupies half a minute; so that the movement of the clock may be maintained for a much longer time than in those in which the escapement is acted upon every second or half second. Accordingly, the clock sent to the exhibition is said to be capable of going an entire year, without requiring to be wound up. The committee look upon this as a new and interesting instrument, and recommend it as worthy of the award of a silver medal.

No. 872, transit or meridian circle, made by Wm. J. Young. This remarkable instrument is a most successful example of the highest class of mechanical skill. It is an exact copy of a meridian circle made by Ertel and Sons, at Munich, and now at the High School observatory in Philadelphia. A description of it cannot be introduced into this report; but the committee have pleasure in expressing their belief that it is the most perfect, as well as the most difficult, work of the kind ever executed in this country, and, as such, they recommend that it have the award of a silver medal.

Cast Iron Buildings.—A correspondent of the Times says:—"Buildings of cast-iron are daily increasing, at a prodigious rate, in England, and it appears that houses are about to be constructed of this material. It is proposed that the walls shall be hollow, so that the whole house may be heated by a single stove in the kitchen. A three-story house, containing ten or twelve rooms, will only cost about £1000; and it may be taken to pieces, and removed to another place, at an expense of about £25. It is understood that a large number are about to be manufactured, to be sent to Hamburg, for those persons who have had their habitations burnt."—*London Athenæum.*

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